

# **Worldwide Open Proficiency Test for Nuclear and Related Analytical Techniques Laboratories**

**PTNATIAEA18**

**Determination of Major, Minor and  
Trace Elements in a Sandy Soil Sample**

PTNATIAEA18 – 14 May 2021



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## **FOREWORD**

The IAEA assists its Member States laboratories to continuously improve their analytical performance by producing reference materials, by developing standardized analytical methods, and by conducting inter-laboratory comparisons and proficiency tests. To ensure a reliable worldwide, rapid and consistent response, the IAEA Nuclear Science and Instrumentation Laboratory in Seibersdorf, Austria, coordinates proficiency tests for Member States laboratories.

This summary report presents the results of the worldwide proficiency test PTNATIAEA18 on the determination of major, minor and trace elements in a sandy soil sample. Methodologies, statistical analysis, and evaluation of results (for each element and for each laboratory) are also reported. The test was carried out within the IAEA project Nuclear Instrumentation, under the Accelerators and Nuclear Spectrometry Subprogram, Nuclear Science Program. The main objective of the project is to enhance capability of interested Member States in effective utilization of nuclear spectrometry and analytical services in industry, human health, agriculture, and in monitoring and evaluation of the environment.

This proficiency test was designed to identify potential analytical problems, to support IAEA Member States laboratories to improve the quality of their analytical results, to maintain their accreditation and to provide a regular forum for discussion and technology transfer in this topic.

The coordinator of the proficiency test and responsible for this publication was Mr. A. Migliori of the IAEA Nuclear Science and Instrumentation Laboratory, Department of Nuclear Sciences and Applications. The IAEA acknowledges the valuable contribution of the international expert Mr. P. Bode (Netherlands). Acknowledgments go also to Mr. N. Pessoa Barradas of the IAEA Physics Section and to Mr. R. Padilla Alvarez of the IAEA Nuclear Science and Instrumentation Laboratory for their support throughout the whole implementation of the test and to Mr. R. Fernandez Roque (Cuba) for the maintenance and upgrades to the PT-NSIL website.



## 1. INTRODUCTION

The PTNATIAEA18 proficiency test was aimed at nuclear and related analytical techniques laboratories. The participants were requested to use their established and proven analytical procedures for the determination of major, minor and trace elements in a sandy soil sample.

Sandy soil samples with established homogeneity and well characterized known target values of the mass fractions of measurands (e.g., chemical elements) were distributed to participating laboratories. The laboratories were requested to analyse the samples using established techniques following their analytical procedures. Based on the results of the proficiency test presented in this report, each participating laboratory should assess its analytical performance by using the specified criteria and, if appropriate, to identify discrepancies, and to correct relevant analytical procedures.

The feasibility of the proficiency test was partially hindered by the critical situation related to the COVID-19 pandemic, especially for what concerns the distribution of the samples and the accessibility of some of the participants to their laboratory. The Proficiency Test was announced on 5 February 2020. The sandy soil samples were distributed to most of the participating laboratories by August 2020. The deadline for submission of the results was 28 February 2021 after postponements related to the problems mentioned above. The proficiency test was implemented exploiting a web based platform [1] to facilitate and improve the processes and actions required for the organization and functionality of the exercise for the participants and the coordinator. Detailed instructions for analysts were also available on the website.

The most recent exercises were already organized according to the recommendations stated in the ISO/IEC 17043:2010 “Conformity assessment - General requirements for proficiency testing” [2]. In the data evaluation of this exercise, a remarkable upgrade of the statistical methods for data treatment was implemented, in order to adhere to the procedures recommended in the ISO 13528:2015 “Statistical methods for use in proficiency testing by interlaboratory comparison” [3]. Consequently, some of the scores and procedures that were used in exercises organized until now have now been replaced by different ones. The new statistical method approach will be illustrated in details in the following paragraphs; the main changes can be anyway summarized in the list below:

- The consensus value of the participants' results and relative standard deviation is determined with robust statistics
- Depending on the uncertainty of the assigned value,  $z$ -scores or  $z'$ -scores are considered
- $u$ -scores are replaced by *Zeta*-scores
- The definition of “outliers” is different; also the term “blunder” is used to identify extreme outliers
- The fit-for-purpose three levels of standard deviation of the assigned value is no longer applied
- The ratios of the participant's results to the assigned values ( $R$ -scores) are also used, since they are often easier to interpret than  $z$ -scores

The submitted results were processed, grouped versus measurands/participants and compared with the measurand's assigned values. The assigned values were based on either the values of the mass fractions certified by the material producer or the consensus values of the participants' results (when no assigned value from the material producer was available and the distribution of results justified considering the consensus value as the assigned one). In some case the determination of consensus values from participants' results was not feasible.

The values of  $z$ - or  $z'$ -score as well as *Zeta*-scores and *R*-scores were calculated on basis of the assigned values. For the definitions of the  $z$ -,  $z'$ -, *Zeta*- and *R*-scores please see Section 3.4.

The obtained results as well as the description of the data evaluation procedures are described in this report. Each laboratory was assigned a code, therefore full anonymity of the presented results is guaranteed. The link between the laboratory code and the laboratory name is known only to the organizers of the proficiency test and to the laboratory itself.

## 2. DESCRIPTION OF THE TEST SAMPLE

The test sample was a sandy soil sample prepared and tested by an external provider through an independent inter-laboratory survey. The powdered, homogenized, and dried material was distributed to 103 participants in plastic bags, each containing around 40 g of the test sample. The participants were asked to conduct the determination of the mass fractions of chemical elements constituting the sample according to their routine analytical procedures. They were also instructed to determine the moisture content of the material by using a separate sample and to report the results on a dry-weight basis. Only one result per element per analytical technique should be submitted. Each result should be accompanied by an estimate of its uncertainty expressed as one standard deviation. No restriction on the number of the reported elements was imposed.

## 3. DETAILS OF THE EXERCISE

### 3.1. TERMS AND DEFINITIONS OF PARAMETERS USED IN THE TEST

Terminology and symbols are defined by ISO 13528:2015. The most important are shown below, and are, where appropriate, clarified for the PTNATIAEA test.

**assigned value  $x_{pt}$ :** is the value attributed to a particular property of the PTNATIAEA proficiency test item (in the case of this exercise, the elemental mass fraction). Assigned values  $x_{pt}$  can be obtained by formulation (i.e., by mixing materials with different known levels of a property in specified proportions, or by adding a specified proportion of a substance to a base material), using a certified reference material, as results from one laboratory, as consensus value from expert laboratories or as consensus value from participant results.

In the case of this test, assigned values can be available as the ones certified by the external provider of the material through an independent inter-laboratory survey organized by the external provider itself. When not available, they can be determined as consensus values of

the results of the participants in the PTNATIAEA test, through the application of robust statistic methods (see Section 3.2 for more details).

**standard deviation of the assigned value  $SD$ :** is the standard deviation of the certified property values, as declared by the provider of the PTNATIAEA test item. When not available, it can be determined as standard deviation of the results of the participants in the PTNATIAEA test, through the application of robust statistic methods ( $s^*$ , see below).

**uncertainty of the assigned value  $u(x_{pt})$ :** is the combined standard uncertainty of the assigned value. It is composed of the following contributions:

$$u(x_{pt}) = \sqrt{u_{char}^2 + u_{hom}^2 + u_{trans}^2 + u_{stab}^2} \quad (1)$$

Where  $u_{char}$  is the uncertainty due to characterization,  $u_{hom}$  is related to the homogeneity between items (covering both the between-bottle and within-bottle inhomogeneity),  $u_{trans}$  is due to instability under transport conditions and  $u_{stab}$  is related to the stability of the material in the period during the test.

Typically, the first one,  $u_{char}$ , is obtained from the provider of the material or by other tests and may sometimes already include estimates of the contributions of the others, especially  $u_{hom}$  and  $u_{stab}$ . If the external provider has characterized its material one basis on its independent interlaboratory study, it is assumed that the standard deviation  $SD$  of the certified property values cover  $u_{hom}$ ,  $u_{trans}$  and  $u_{stab}$ . If the property values have been declared as “certified” by the external provider, obtained through such an independent inter-laboratory survey  $u(x_{pt})$  is determined as the standard deviation of the mean, i.e., the standard deviation of the certified property value  $SD$  divided by the square root of the number  $N$  of participants in that inter-laboratory survey:  $u(x_{pt}) = SD/\sqrt{N}$ .

When certified values are not available from the provider of the material,  $u(x_{pt})$  can be obtained from the results of the participants, through the application of robust statistic methods (see Section 3.2 for more details). The valued of  $u(x_{pt})$  is determined in this case as:

$$u(x_{pt}) = 1.25 \cdot \frac{s^*}{\sqrt{p}} \quad (2)$$

with  $s^*$  = participant standard deviation (see below) and  $p$  = number of results for that element in this test.

**consensus value  $x^*$ :** is the value derived from a collection of results in the PTNATIAEA interlaboratory comparison. It is obtained from robust statistics of the submitted results (see Section 3.2 for more details). It can be used as assigned value for elements that are not certified by the material’s provider.

**participant standard deviation  $s^*$ :** is the estimate of the participant standard deviation derived from a collection of results in the PTNATIAEA interlaboratory comparison. It is obtained from robust statistics of the submitted results (see Section 3.2 for more details).

**standard deviation for proficiency assessment**  $\sigma_{pt}$ : is a measure of dispersion used in the evaluation of results of the PTNATIAEA proficiency testing. In the data treatment of this exercise, the standard deviation for proficiency assessment  $\sigma_{pt}$  is determined, in the case of assigned values (either available from the external provider of the material or obtained as consensus values from the submitted results) from a modified Horwitz function ( $\sigma_R$ ), which is defined [3,4] as (please note that  $x_{pt}$  and  $\sigma_{pt}$  are considered as mass fractions [g/g]):

$$\sigma_{pt} = \sigma_R = \begin{cases} 0.22x_{pt} & \text{when } x_{pt} < 1.2 \cdot 10^{-7} \\ 0.02(x_{pt})^{0.8495} & \text{when } 1.2 \cdot 10^{-7} \leq x_{pt} \leq 0.138 \\ 0.01\sqrt{x_{pt}} & \text{when } x_{pt} > 0.138 \end{cases} \quad (3)$$

The relative value of the standard deviation for proficiency assessment ( $\frac{\sigma_{pt}}{x_{pt}} \cdot 100$ ) as a function of the assigned mass fraction of the measurand,  $x_{pt}$ , is shown in Fig. 1.

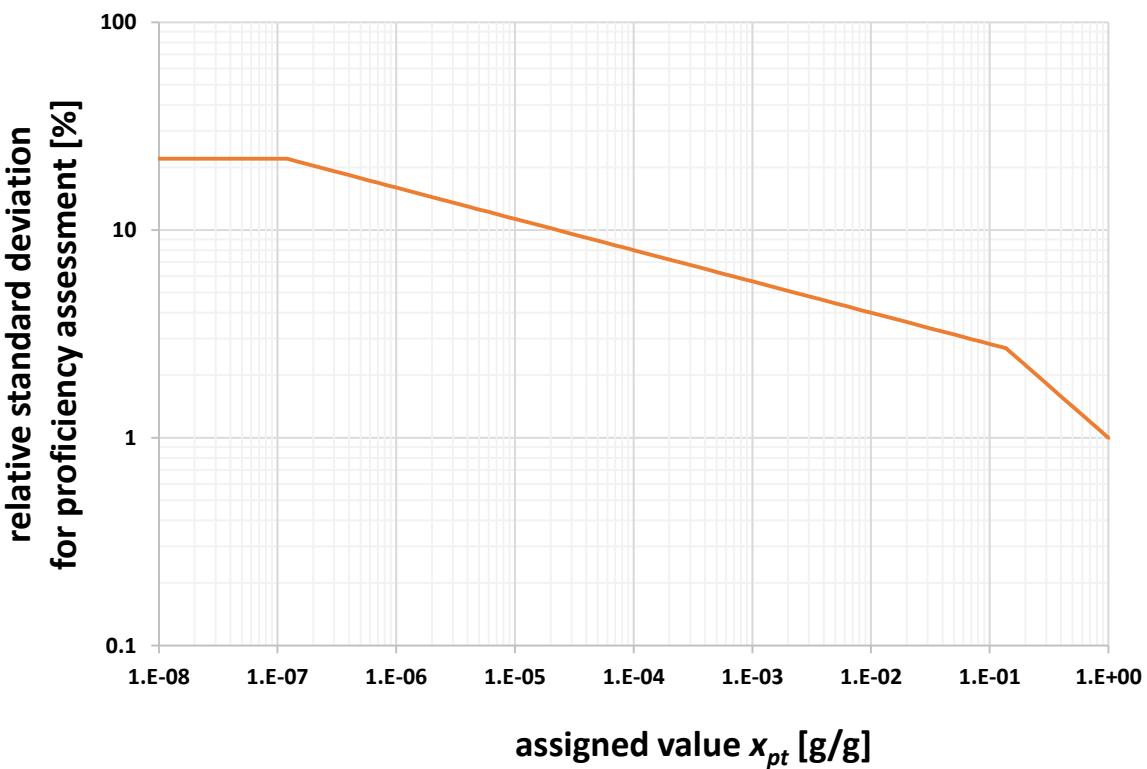


FIG. 1. Relative value of the standard deviation for proficiency assessment, as a function of the assigned mass fraction of the measurand, calculated by using a modified Horwitz function, Eqn. (3).

This approach gives a general model for the reproducibility of analytical methods. The Horwitz model is empirical, based on observations from collaborative trials of many parameters over an extended time period. The  $\sigma_R$  values are the expected upper limits of interlaboratory variability when the collaborative trial had no significant problems. Therefore, a comparison of  $\sigma_R$  with  $s^*$  gives indications about the variability of the results in the test. Furthermore, it is also worth comparing  $\sigma_R$  with the standard deviation of the distributions obtained by the external provider of the material from its independent inter-laboratory survey.

Preferably, this standard deviation of the distribution should be of the same order of magnitude as  $\sigma_R$ .

### 3.2. ROBUST STATISTICS

No limits were set to the number of measurands (chemical element) to be reported. Participants were asked to report only one measurement value for each measurand, also if they have made measurement in replicates.

After receiving the results from the participants the median of the distribution was determined for every element. Those results that differed more than an order of magnitude from the median were considered as “blunder outliers” (later on, “blunders”) and were not further considered in the application of robust statistics.

For those elements having 5 or more reported valid (i.e., “no-blunder”) results, the consensus values  $x^*$  and the participant standard deviations  $s^*$  were determined using the Algorithm A approach of the ISO 13528:2015, described below.

The results submitted (total number  $p \geq 5$ ) are sorted into increasing order:

$$x_1, x_2, \dots, x_p$$

the initial values of robust average and robust standard deviation of these data are denoted by  $x_I^*$  and  $s_I^*$ , respectively. They are determined from the set of  $p$  values as:

$$x_I^* = \text{median}$$

$$s_I^* = 1.483 \cdot MAD = MAd$$

where  $MAD$  is the median absolute deviation and  $MAd$  the scaled median absolute deviation. The following quantity is then defined:

$$\delta_I = 1.5 \cdot s_I^* \quad (4)$$

Each  $x_i$  is replaced according to the rules below:

$$x_i^* = \begin{cases} x_I^* - \delta_I & \text{when } x_i < x_I^* - \delta_I \\ x_I^* + \delta_I & \text{when } x_i > x_I^* + \delta_I \\ x_i & \text{otherwise} \end{cases} \quad (5)$$

The new values of robust average and robust standard deviation are denoted by  $x_{II}^*$  and  $s_{II}^*$ , respectively, and are determined as:

$$x_{II}^* = \frac{\sum_{i=1}^p x_i^*}{p} \quad (6)$$

$$s_{II}^* = 1.134 \sqrt{\frac{\sum_{i=1}^p (x_i^* - x_{II}^*)^2}{(p-1)}} \quad (7)$$

The final robust estimates are then derived by an iterative calculation, i.e., by updating the values of  $x^*$  and  $s^*$  several times using equations (4) to (7) until the process converges. Convergence is assumed when there is no change from one iteration to the next in the third significant figures of the robust mean and robust standard deviation. Those two quantities are finally considered as consensus value ( $x^*$ ) and participant standard deviation ( $s^*$ ) of the distribution.

The consensus value  $x^*$  and participant standard deviation  $s^*$  have not been determined if the number of valid submitted results was less than 5. In such cases, the  $z$ -,  $z'$ -, *Zeta*- and *R*-scores have been calculated only if certified values by the external provider were available.

### 3.3. DETERMINATION OF OUTLIERS

As stated in the previous Section, blunders are those values that differ more than an order of magnitude from the median of the submitted results and are not further considered in the application of robust statistics.

Assigned values can be the ones determined by the external provider of the material or, when not available, can be obtained through robust statistic methods as consensus values of the results of the participants. Outliers are defined as the values that differ more than 4.5 standard deviations from the assigned value. This means that for assigned values determined by the external provider of the material, the standard deviation  $SD$  is the one declared by the producer itself, so  $(x_i)_{outlier-} < x_{pt} - 4.5 \cdot SD$  and  $(x_i)_{outlier+} > x_{pt} + 4.5 \cdot SD$ ; otherwise, for assigned values obtained through robust statistic methods as consensus values of the results of the participants, the value  $s^*$  is considered:  $(x_i)_{outlier-} < x_{pt} - 4.5 \cdot s^*$  and  $(x_i)_{outlier+} > x_{pt} + 4.5 \cdot s^*$ .

Please note that outliers, differently from the blunders, are taken into account for the determination of  $x^*$  and  $s^*$  through robust statistics. Since for few elements, after removal of blunders, the distribution of results shows a multi-modal behaviour, also the values of  $x^*$  and  $s^*$  after outlier removal are shown for every element, in order to get indications on how deeply outliers affect the results of robust statistics (see Table 3).

Outliers were not calculated for those elements having more than 5 valid results but for which the assigned values were neither determined by the external provider of the material nor calculated from the submitted results (see Section 4). In such cases, only blunders were determined.

### 3.4. PERFORMANCE INDICATORS

All reported mass fractions of measurands (including those identified as blunders and outliers) were compared with the assigned values by using different performance indicators.

In case  $u(x_{pt}) \leq 0.3\sigma_{pt}$ , for every result a  $z$ -score was calculated, defined as:

$$z_i = \frac{(x_i - x_{pt})}{\sigma_{pt}} \quad (8)$$

in which the term  $x_i$  denotes the reported mass fraction of the measurand.

If  $u(x_{pt}) > 0.3\sigma_{pt}$ , for every result a  $z'$ -score was calculated, defined as:

$$z'_i = \frac{(x_i - x_{pt})}{\sqrt{\sigma_{pt}^2 + u^2(x_{pt})}} \quad (9)$$

The conventional interpretation of  $z$ - or  $z'$ -scores is as follows (see also ISO/IEC 17043:2010, B.4.1.1):

- $|z, z'| \leq 2$  the result is considered acceptable
- $2 < |z, z'| < 3$  the result is considered to give a warning signal
- $|z, z'| \geq 3$  the result is considered to be unacceptable (or action signal)

Generally speaking, any  $z$ - or  $z'$ -score for an element outside the range  $-2 \leq z \leq 2$  should be examined by the analyst and all steps of the analytical procedure verified to identify the source(s) of the analytical bias.

The reported results were accompanied by the standard uncertainty estimate made by the participant. The values were used to calculate the *Zeta*-scores:

$$\zeta_i = \frac{x_i - x_{pt}}{\sqrt{u^2(x_i) + u^2(x_{pt})}} \quad (10)$$

Where  $u(x_i)$  is the participant's own estimate of the standard uncertainty of its result  $x_i$ . Please note that this definition differs from the one of  $u$ -scores, as for *Zeta*-scores  $u(x_{pt})$  replaces  $\sigma_{pt}$ . In principle, the same interpretation as described in the above for the  $z$ - and  $z'$ -scores may be applied to *Zeta*-scores.

In order to provide a performance indicator having an easier and more intuitive interpretation than  $z$ - and  $z'$ -scores, the values of the ratios  $R_i$  will be also reported:

$$R_i = \frac{x_i}{x_{pt}} \quad (11)$$

Although this parameter is not defined and included in the ISO 13528:2015, its values can provide to the participant a more direct feedback on the data submitted.

## 4. RESULTS

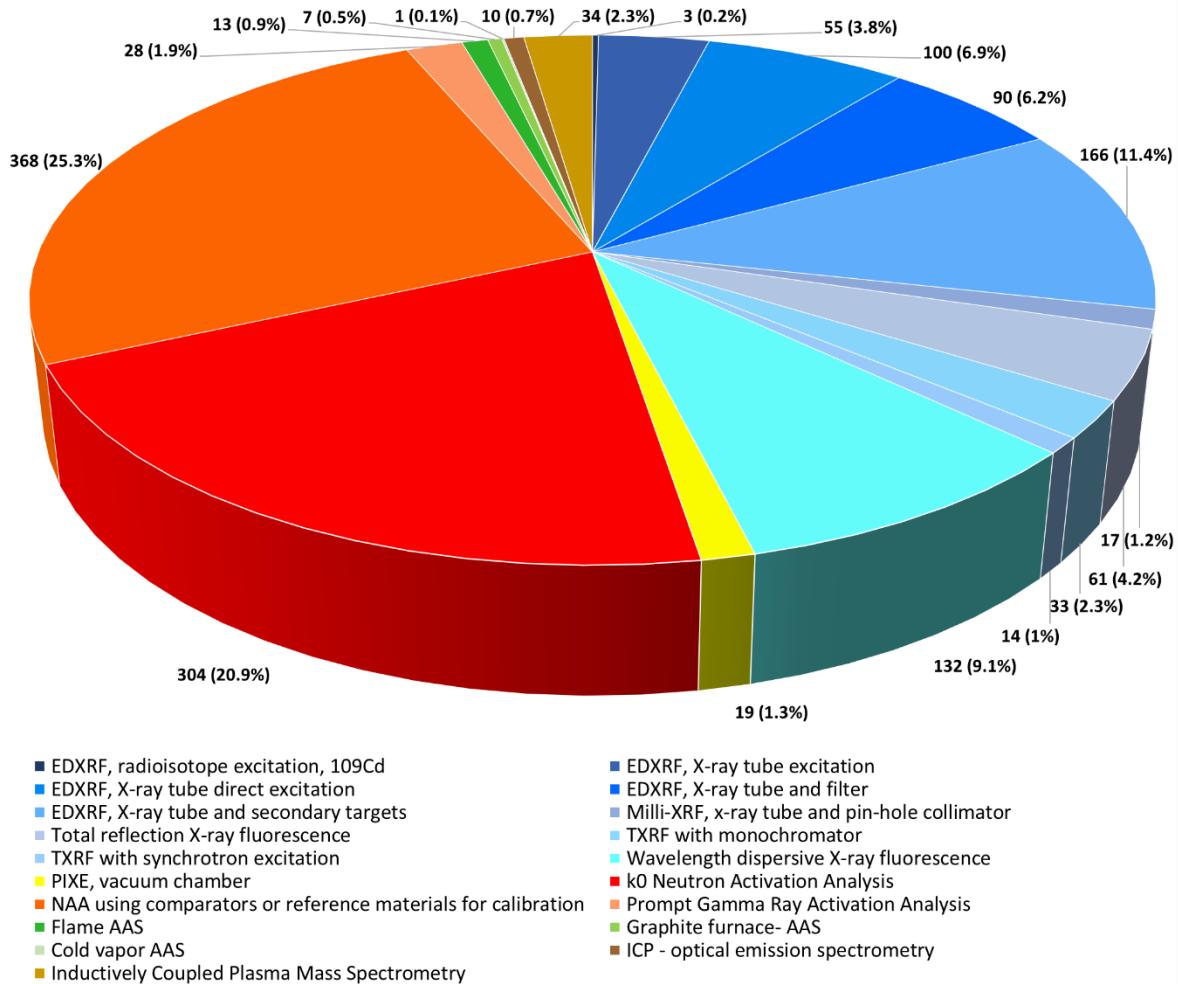
The invitation was accepted by 103 analysts; the test samples were finally distributed to 97 of them, in the remaining 6 cases problems were faced in delivering the parcel to the final consignee. Out of the 97 analysts, 70 (from 68 laboratories distributed in 44 Member States) participated in the test submitting 1455 individual results for 65 chemical elements. All submitted results have been evaluated. The list of the participating laboratories is presented at the end of this report.

When participants were uploading their results, they were asked first to specify which technique was used for sample preparation and analysis from a list of options. In principle, one participant could submit results with different techniques for different elements. The analytical techniques used by the participants, their codes and abbreviations and corresponding number of results are listed in Table 1.

Fig. 2 represents the proportion of results submitted according to the analytical techniques used. Most of the analyses were carried out either by Neutron Activation Analysis (about 48%, reddish shades) or by X-Ray Fluorescence spectrometry (about 46%, bluish shades). Particle Induced X-ray Emission results account for 1.3% of the total number of results, Atomic Absorption Spectrometry techniques for 1.4% (greenish shades) and Inductively Coupled Plasma Spectrometry techniques for 3% (brownish shades).

TABLE 1. THE CODING, DESCRIPTION AND THE ABBREVIATED NAMES OF THE ANALYTICAL TECHNIQUES USED BY PARTICIPANTS OF THE PROFICIENCY TEST EXERCISE AND THEIR CORRESPONDING NUMBER OF RESULTS.

<b>Code Description</b>	<b>Abbreviation</b>	<b>Results</b>	<b>Blunders</b>	<b>Percent</b>	<b>Outliers</b>	<b>Percent</b>
1.13 EDXRF, radioisotope excitation, 109Cd	EDXRFTISO-CD	3	-	-	-	-
1.2 EDXRF, X-ray tube excitation	EDXRFTUBE	55	2	3.6	32	58.2
1.21 EDXRF, X-ray tube direct excitation	EDXRFTUBE-DIRECT	100	9	9.0	54	54.0
1.22 EDXRF, X-ray tube and filter	EDXRFTUBE-FILTERS	90	8	8.9	33	36.7
1.23 EDXRF, X-ray tube and secondary targets	EDXRFTUBE-ST	166	10	6.0	58	34.9
1.24 Milli-XRF, x-ray tube and pin-hole collimator	m-XRF	17	-	-	2	11.8
1.3 Total reflection X-ray fluorescence	TXRF	61	-	-	8	13.1
1.32 TXRF with monochromator	TXRF-MON	33	2	6.1	4	12.1
1.33 TXRF with synchrotron excitation	TXRF-SYNC	14	-	-	1	7.1
2.0 Wavelength dispersive X-ray fluorescence	WDXRF	132	6	4.6	55	41.7
4.2 PIXE, vacuum chamber	PIXE-VAC	19	-	-	12	63.2
5.1 $k_0$ Neutron Activation Analysis	K0 NAA	304	3	1.0	10	3.3
5.2 Neutron Activation Analysis using comparators or reference materials for calibration	CNAA	368	4	1.1	26	7.1
5.4 Prompt Gamma Activation Analysis	PGAA	28	1	3.6	3	10.7
6.1 Flame AAS	FAAS	13	-	-	3	23.1
6.2 Graphite furnace- AAS	GFAAS	7	-	-	2	28.6
6.4 Cold vapor AAS	CVAAS	1	-	-	-	-
7.1 ICP - optical emission spectrometry	ICP-OES	10	2	20.0	-	-
7.2 Inductively Coupled Plasma Mass Spectrometry	ICP-MS	34	2	5.9	6	17.7



**FIG. 2. Utilization of analytical techniques.** For each analytical technique the number of submitted results is shown. The percent values relate to the total number of 1455 submitted results.

Out of the 65 reported elements, for 35 the assigned value was available from the external provider of the material.

For 7 other elements, indicative values were available by the external provider but they were not considered as assigned values for the test. These values are reported in brackets in Tables 2 and 3.

For 12 elements (Cs, Dy, Eu, Hf, Lu, Nd, Sc, Sm, Ta, Tb, Yb) the consensus values from the submitted results was considered as assigned value. These elements are reported in italic type in the tables.

In the case of other 6 elements (Cl, Ga, I, S, Se, Zn) the distribution of results was very broad, even having a total number – after blunders removal – above 5. No assigned value could be therefore determined with a sufficient level of confidence. A more objective method was introduced to assess such cases. The standard deviation of the distribution  $s^*$  was compared with the value  $0.3 \cdot x^*$  and if  $s^* \geq 0.3 \cdot x^*$ , the consensus value was not considered as assigned value [5]. In such cases the results from the test were considered inconclusive. As stated above in Section 3.3, outliers were not calculated for these elements, whereas blunders were determined. It is worth noting the case of iodine for which 8 valid results are available: the 6 results from NAA laboratories show a very good agreement, but they are a too small number

and the other 2 results are affecting the robust statistics results quite heavily. As a consequence of the objective rule mentioned in the above, the consensus value  $x^*$  for iodine could not be considered as the assigned one for this element. Nevertheless, for all elements having more than 5 valid results, the consensus value of all results as well as the ones obtained by all XRF laboratories and all NAA laboratories are shown individually (Table 3), allowing for a self-assessment of performance.

All the data submitted by participants or obtained by the external provider of the material are reported with the original number of significant digits. Data calculated by our system ( $x^*$ ,  $s^*$ ,  $u(x_{pt})$ ,  $\sigma_{pt}$ ) were processed keeping significant digits up to the third one after the decimal point, but, for reporting in the tables, were subsequently rounded to the greatest decimal unit (...10, 1, 0.1, 0.01...) which doesn't exceed half of the value of the corresponding uncertainty (for  $x^*$  the value  $1.25 \cdot s^*/\sqrt{p}$  was used) [6]. The values of  $z$ ,  $z'$ ,  $Zeta$  were processed keeping significant digits up to the third one after the decimal point, but then in the tables are shown up to the first digit after the decimal point. The same approach was used for the  $R$ -scores, but they were finally reported in the tables up to the second digit after the decimal point. The performance indicators could therefore be very slightly affected when calculated using the rounded data reported in the tables.

In Table 2 for every element the following parameters are reported:

- Certified property value from external provider (when available). For information, in this column also the indicative values from the external provider are reported in brackets.
- Standard deviation  $SD$  from the external provider
- Consensus value  $x^*$
- Participant standard deviation  $s^*$
- Assigned value  $x_{pt}$ . This is the value from external provider, when available, otherwise is the consensus values  $x^*$  of the submitted results, when the distribution of data is good enough to justify such procedure. When  $x^*$  was considered as  $x_{pt}$ , the data are reported in italic type
- Uncertainty of the assigned value  $u(x_{pt})$
- Standard deviation for proficiency assessment  $\sigma_{pt}$
- Number of results
- Number of blunders
- Number of outliers

Please note that the values used for the determination of the performance indicator are  $x_{pt}$ ,  $\sigma_{pt}$  and  $u(x_{pt})$ .

Table 3 shows for every element the consensus value  $x^*$  and the participant standard deviation  $s^*$ , as obtained (after removal of blunders) from the whole set of results, after removing the outliers and for XRF results only and for NAA results only. Values of  $x^*$  have been rounded to the correspondent value of uncertainty, determined as  $1.25 \cdot s^*/\sqrt{p}$ .

TABLE 2. CERTIFIED (PROVIDER) VALUES OF MEASURANDS, CONSENSUS VALUES, PROFICIENCY TEST PARAMETERS, TOTAL NUMBER OF RESULTS, NUMBER OF BLUNDERS AND NUMBER OF OUTLIERS.

Measurand symbol	Value from external provider	SD from external provider	$x^*$	$s^*$	$x_{pt}$	$u(x_{pt})$	$\sigma_{pt}$	Number of results	Number of blunders	Number of outliers
[%]										
Al	1.04	0.091	1.71	0.9	1.04	0.01	0.04	42	1	20
C	5.33	0.62	-	-	5.33	0.06	0.17	2	0	0
Ca	0.041	0.01	0.072	0.05	0.041	0.001	0.003	38	3	10
Fe	0.704	0.059	0.87	0.3	0.704	0.006	0.03	66	1	22
K	0.525	0.04	0.61	0.2	0.525	0.004	0.02	60	0	21
Na	0.136	0.025	0.156	0.05	0.136	0.003	0.007	41	3	3
Si	40.3	0.66	37.8	8	40.3	0.08	0.6	32	0	24
Ti	0.109	0.011	0.147	0.07	0.109	0.001	0.006	51	0	17
[mg/kg]										
As	4.51	0.716	5.0	1.2	4.51	0.09	0.6	39	4	5
Ba	128	12.5	139	40	128	1.4	10	37	2	9
Br	24.2	2.24	26.0	8	24.2	0.4	2	42	1	10
Cd	0.272	0.035	-	-	0.272	0.006	0.05	6	2	0
Ce	17.2	4.17	17.5	4	17.2	0.7	1.8	28	0	2
Cl	-	-	140	80	-	-	-	18	1	0
Co	1.49	0.37	1.76	0.5	1.49	0.05	0.2	30	0	5
Cr	81.9	9.83	101	30	81.9	1.0	7	58	2	13
Cu	9.81	1.933	19	10	9.81	0.2	1.1	33	1	16
F	-	-	-	-	-	-	-	1	0	0
La	8.2	1.935	8.9	1.7	8.2	0.3	1.0	32	0	3
Li	9.33	0.773	-	-	9.33	0.17	1.1	2	0	0
Mg	340	69.4	1000	900	340	9	20	23	3	11
Mn	55.5	8.49	70	30	55.5	0.9	5	54	1	11
Mo	4.58	0.767	4.6	1.6	4.58	0.10	0.6	13	0	2
Nb	3.87	0.932	9	6	3.87	0.16	0.5	8	0	4
Ni	25.8	4.61	32	13	25.8	0.5	3	33	1	5
P	175	31.9	740	400	175	4	13	17	0	15
Pb	19.6	2.55	27	11	19.6	0.3	2	35	0	9
Rb	24.7	1.97	27.6	7	24.7	0.3	2	53	0	12
S	(266)	(71.1)	830	400	-	-	-	16	0	0
Sb	0.796	0.197	0.75	0.19	0.796	0.04	0.13	27	1	2
Sr	21.6	2.37	25.8	7	21.6	0.3	2	40	1	9
Th	3.11	0.546	3.15	0.6	3.11	0.10	0.4	35	1	3

Measurand symbol	Value from external provider	SD from external provider	$x^*$	$s^*$	$x_{pt}$	$u(x_{pt})$	$\sigma_{pt}$	Number of results	Number of blunders	Number of outliers
Tl	0.171	0.027	-	-	0.171	0.006	0.04	2	0	0
U	0.994	0.246	1.03	0.3	0.994	0.05	0.16	23	1	4
V	14.3	2.2	20	11	14.3	0.3	1.5	32	0	9
Y	6.64	1.156	11.2	5	6.64	0.19	0.8	12	0	6
Zr	216	20.5	256	80	216	3	15	37	0	10
[ug/kg]										
Ag	-	-	-	-	-	-	-	5	2	0
B	-	-	-	-	-	-	-	1	0	0
Bi	-	-	-	-	-	-	-	1	0	0
Cs	-	-	1280	300	1280	70	200	26	1	3
Dy	-	-	1070	150	1070	60	170	10	0	0
Eu	-	-	204	30	204	7	40	23	0	2
Ga	(3870)	(1313)	4400	1700	-	-	-	16	1	0
Gd	-	-	-	-	-	-	-	4	0	0
Ge	-	-	-	-	-	-	-	3	0	0
Hf	-	-	6010	700	6010	190	700	25	1	0
Hg	51.2	7.46	500	700	51.2	1.0	11	5	0	3
Ho	-	-	-	-	-	-	-	2	0	0
I	(7190)	(2168)	11000	5000	-	-	-	8	0	0
Lu	-	-	136	20	136	8	30	11	0	0
Nd	(6960)	(2535)	7200	1500	7200	500	900	14	1	2
Pd	-	-	-	-	-	-	-	1	0	0
Pr	-	-	-	-	-	-	-	2	0	0
Ru	-	-	-	-	-	-	-	1	0	0
Sc	-	-	1320	300	1320	60	200	31	1	3
Se	-	-	700	500	-	-	-	9	1	0
Sm	-	-	1230	180	1230	40	190	28	0	2
Sn	(1440)	(544)	-	-	-	-	-	6	2	0
Ta	-	-	311	40	311	14	60	17	1	0
Tb	-	-	173	30	173	10	40	15	0	1
Tm	-	-	-	-	-	-	-	1	0	0
W	(966)	(274.5)	-	-	-	-	-	6	2	0
Yb	-	-	810	150	810	50	130	17	0	1
Zn	(10700)	(2750)	15700	7000	-	-	-	49	6	0

TABLE 3. CONSENSUS VALUE  $x^*$  AND PARTICIPANT STANDARD DEVIATION  $s^*$  FOR THE WHOLE SET OF RESULTS, AFTER REMOVING THE OUTLIERS AND ONLY FOR XRF RESULTS AND ONLY FOR NAA RESULTS.

Measurand symbol	Value from external provider	SD from external provider	Total		No outliers		XRF		NAA	
			$x^*$	$s^*$	$x^*$	$s^*$	$x^*$	$s^*$	$x^*$	$s^*$
[%]										
Al	1.04	0.091	1.71	0.9	1.09	0.14	2.2	1.1	1.15	0.2
C	5.33	0.62	-	-	-	-	-	-	-	-
Ca	0.041	0.01	0.072	0.05	0.046	0.014	0.081	0.06	0.047	0.011
Fe	0.704	0.059	0.87	0.3	0.682	0.09	1.06	0.5	0.70	0.08
K	0.525	0.04	0.61	0.2	0.509	0.07	0.70	0.3	0.514	0.06
Na	0.136	0.025	0.156	0.05	0.142	0.03	0.22	0.10	0.137	0.015
Si	40.3	0.66	37.8	8	40.5	1.5	38	9	38	5
Ti	0.109	0.011	0.147	0.07	0.104	0.016	0.175	0.09	0.103	0.011
[mg/kg]										
As	4.51	0.716	5.0	1.2	4.62	0.7	10	6	4.52	0.6
Ba	128	12.5	139	40	123	15	168	60	124	14
Br	24.2	2.24	26.0	8	23.1	3	29	13	24.1	3
Cd	0.272	0.035	-	-	-	-	-	-	-	-
Ce	17.2	4.17	17.5	4	16.8	3	31	15	16.1	2
Cl	-	-	140	80	140	80	200	140	113	40
Co	1.49	0.37	1.76	0.5	1.57	0.3	7	5	1.54	0.3
Cr	81.9	9.83	101	30	87	15	128	60	86	13
Cu	9.81	1.933	19	10	12.0	4	20	10	-	-
La	8.2	1.935	8.9	1.7	8.5	1.2	25	20	8.4	1.0
Li	9.33	0.773	-	-	-	-	-	-	-	-
Mg	340	69.4	1000	900	440	130	1100	1000	1700	1800
Mn	55.5	8.49	70	30	59	17	85	30	55.0	7
Mo	4.58	0.767	4.6	1.6	4.1	0.7	4.2	1.6	4.4	0.5
Nb	3.87	0.932	9	6	-	-	9	6	-	-
Ni	25.8	4.61	32	13	28	10	33	14	-	-
P	175	31.9	740	400	-	-	700	300	-	-
Pb	19.6	2.55	27	11	22.2	6	28	13	-	-
Rb	24.7	1.97	27.6	7	25.3	3	29.1	9	26.2	4
S	(266)	(71.1)	830	400	780	400	830	500	-	-
Sb	0.796	0.197	0.75	0.19	0.72	0.16	-	-	0.74	0.17
Sr	21.6	2.37	25.8	7	24.2	5	26.7	7	24	5
Th	3.11	0.546	3.15	0.6	3.03	0.4	4.4	3	3.03	0.4

Measurand symbol	Value from external provider	SD from external provider	Total		No outliers		XRF		NAA	
			$\bar{x}^*$	$s^*$	$\bar{x}^*$	$s^*$	$\bar{x}^*$	$s^*$	$\bar{x}^*$	$s^*$
Tl	0.171	0.027	-	-	-	-	-	-	-	-
U	0.994	0.246	1.03	0.3	0.94	0.16	-	-	0.99	0.14
V	14.3	2.2	20	11	14.6	2	28	16	14.3	1.5
Y	6.64	1.156	11.2	5	7.4	1.6	11.2	5	-	-
Zr	216	20.5	256	80	236	50	270	100	240	60
[ug/kg]										
Cs	-	-	1280	300	1200	160	-	-	1210	200
Dy	-	-	1070	150	1070	150	-	-	1070	150
Eu	-	-	204	30	200	20	-	-	206	30
Ga	(3870)	(1313)	4400	1700	4200	1400	5400	2000	3060	300
Hf	-	-	6010	700	6010	700	-	-	5980	700
Hg	51.2	7.46	500	700	-	-	-	-	-	-
I	(7190)	(2168)	11000	5000	8400	1400	-	-	8000	800
Lu	-	-	136	20	136	20	-	-	136	20
Nd	(6960)	(2535)	7200	1500	6700	800	-	-	6800	900
Sc	-	-	1320	300	1270	190	-	-	1280	180
Se	-	-	700	500	540	300	-	-	-	-
Sm	-	-	1230	180	1200	140	-	-	1200	150
Ta	-	-	311	40	311	40	-	-	311	50
Tb	-	-	173	30	169	30	-	-	169	30
Yb	-	-	810	150	800	140	-	-	800	140
Zn	(10700)	(2750)	15700	7000	15300	7000	18000	9000	12700	3000

Participants submitted results obtained with different nuclear and related analytical techniques (as shown in Table 1). The most used techniques, even if including a variety of “sub-techniques”, were X-Ray Fluorescence, XRF (codes 1.13, 1.2, 1.21, 1.22, 1.23, 1.24, 1.3, 1.32, 1.33, 2.0) and Neutron Activation Analysis, NAA (codes 5.1, 5.2, 5.4). Most of the graphs, like density distributions, will be presented highlighting the data in different colors depending on whether they were obtained by XRF (labelled blue), NAA (labelled red) or other analytical techniques (labelled grey).

The correlation between the values from external provider and the consensus values  $\bar{x}^*$  (for those element with enough results to allow the calculation of the consensus value) is shown in Fig. 3. Figs. 4 and 5 show the same correlation as obtained only by XRF and NAA laboratories (see Table 3), respectively. Please note that some elements might not be present in Figs. 4 and/or 5 due to the fact that the total number of valid results is less than 5.

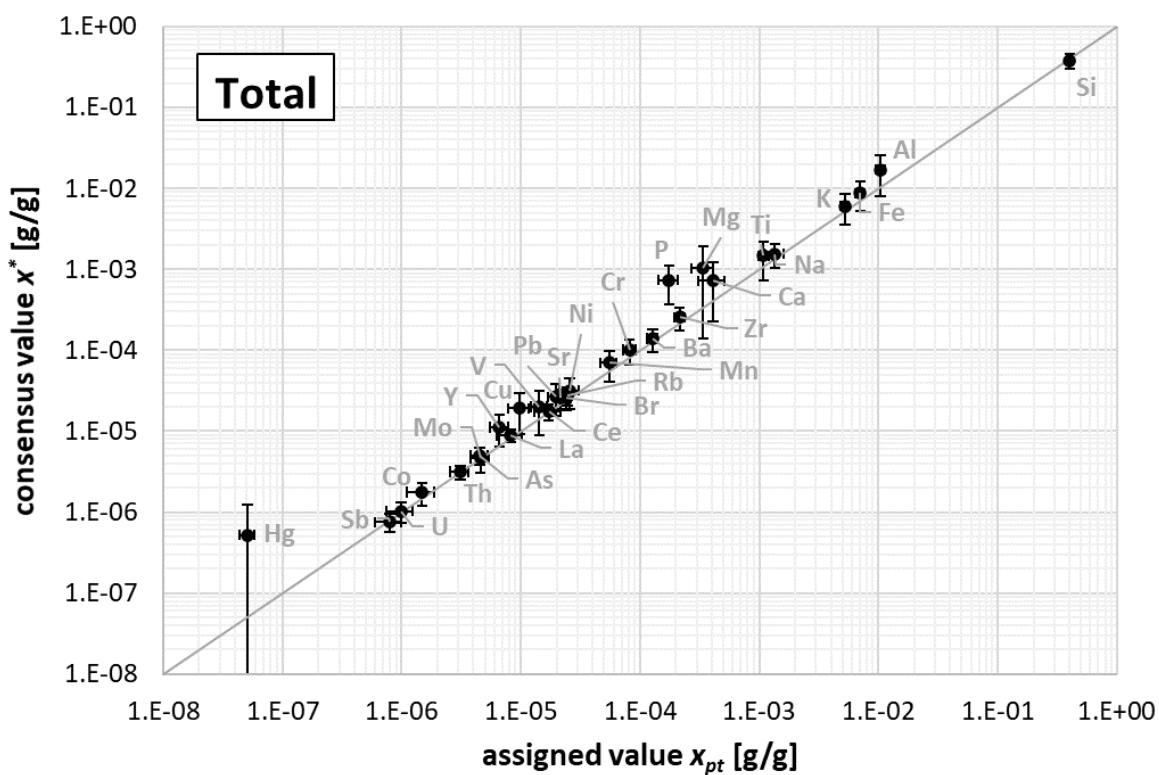


FIG. 3. Correlation between the values from external provider and the consensus values  $x^*$ . The error bars are the standard deviations from the external provider SD and the participant standard deviations  $s$ .

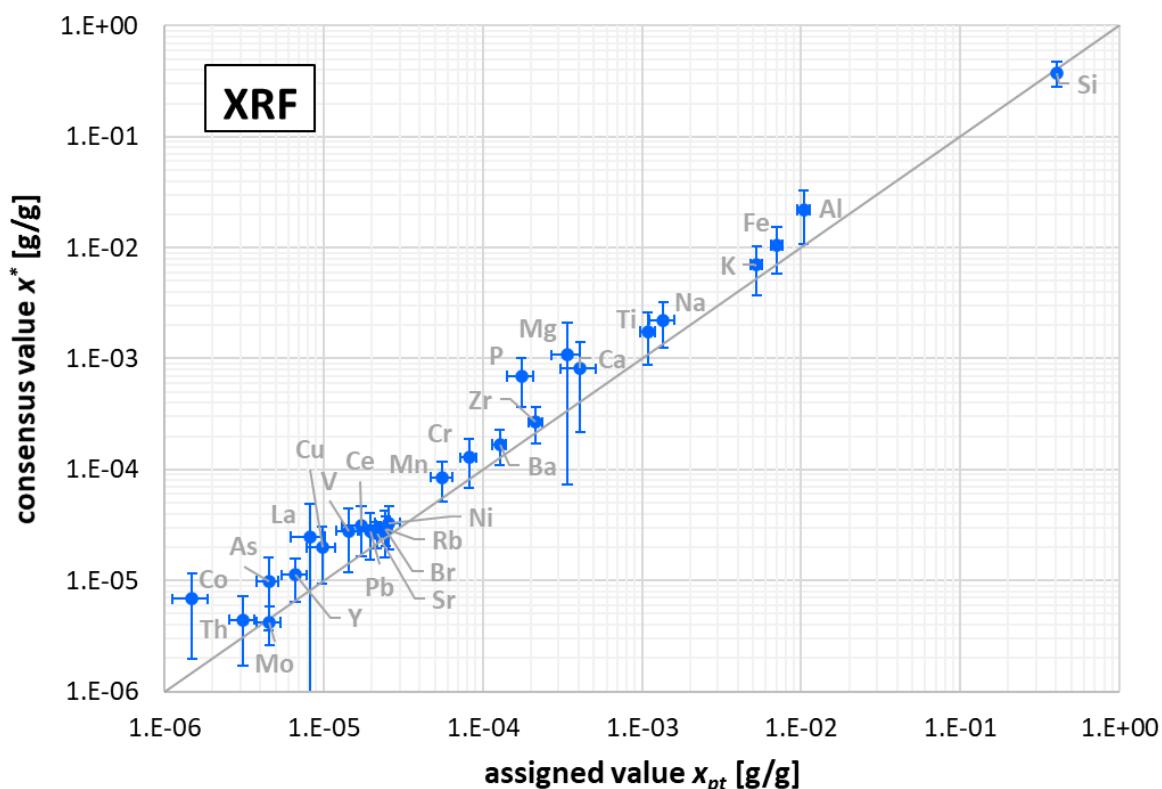


FIG. 4. Correlation between the values from external provider and the consensus values  $x^*$  for the XRF laboratories only. The error bars are the standard deviations from the external provider SD and the participant standard deviations  $s$ .

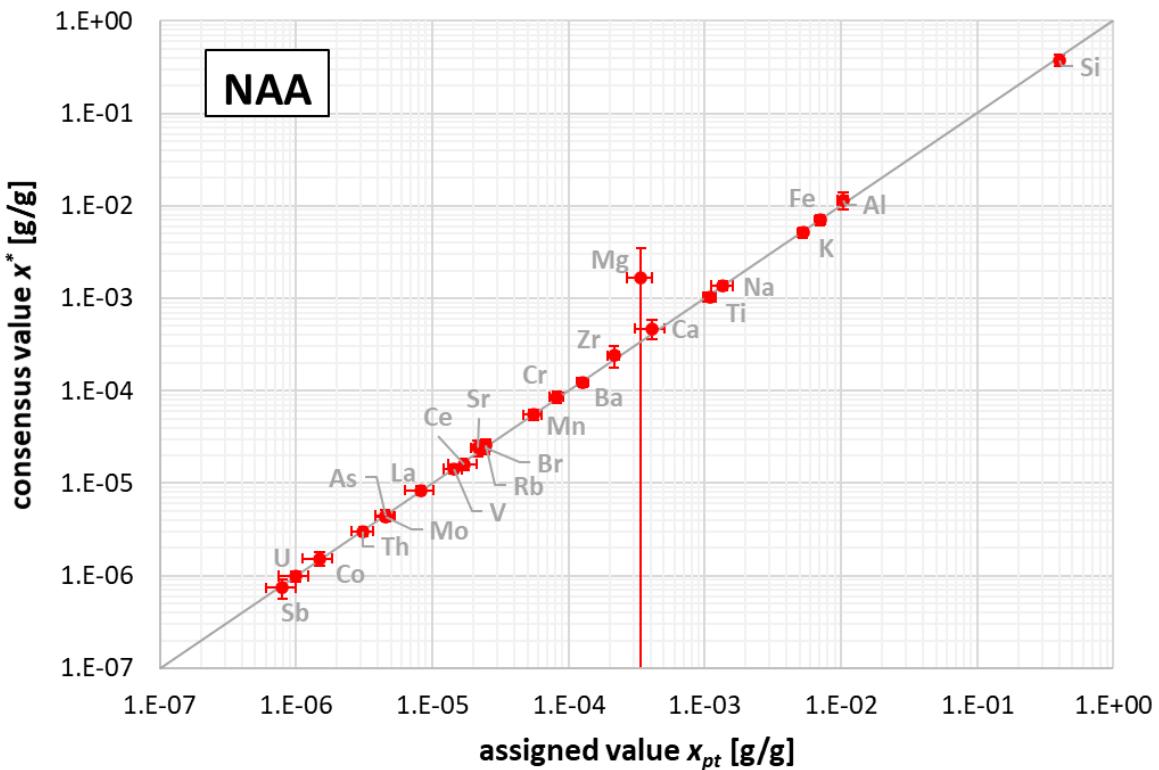


FIG. 5. Correlation between the values from external provider and the consensus values  $x^*$  for the NAA laboratories only. The error bars are the standard deviations from the external provider SD and the participant standard deviation  $s$ .

Table 4 lists, for every element, the values submitted by each participants (measurand mass fraction and standard deviation) and their corresponding calculated performance indicators, i.e.,  $z$ - or  $z'$ -scores, Zeta-scores and  $R$ -scores. In brackets, next to the element symbol, the parameters used to determine the performance indicators are shown, namely the assigned value of element mass fraction  $x_{pt}$ , the standard deviation for proficiency assessment  $\sigma_{pt}$  and the uncertainty of the assigned value  $u(x_{pt})$ . The results that were identified as blunder are marked with “\*\*” and the outliers with “\*” in the “Measurand mass fraction” column. Please note that for some elements, even if the valid results were less than 5 and no consensus value  $x^*$  could be therefore determined, the performance indicators could be obtained since the assigned value was determined by the external provider of the material.

Figs. 6-99 present the distributions of the proficiency test results for the elements having at least 5 valid (no-blunder) results.

In Figs. 6-46 the individual results are marked with filled circles, in blue for XRF, in red for NAA and in grey for the other analytical techniques. Blunders are not shown in these graphs. The density distribution line for all results (excluding the blunders) is shown by the solid black line. The vertical dotted black lines show the range of non-outlier results. The assigned value  $x_{pt}$  is shown as vertical solid green line. In case  $u(x_{pt}) \leq 0.3\sigma_{pt}$ , the range  $\pm 3\sigma_{pt}$  is also shown by vertical dotted green lines. When  $u(x_{pt}) > 0.3\sigma_{pt}$ , the range shown is calculated with  $\sqrt{\sigma_{pt}^2 + u^2(x_{pt})}$  instead of  $\sigma_{pt}$  (see definition of  $z$ - and  $z'$ -scores in Section 3.4). Figs. 47-

52 show the density distributions for those element having more than 5 valid results but for which an assigned value was not available or could not be determined.

Figs. 53-93 show the bar chart distributions of results for the measurands with at least 5 submitted results. The results are sorted in ascending order versus participant/technique code. The bar charts show the distance between the reported and the assigned values of the measurand. The submitted results are accompanied by uncertainty bars. As for the density distribution graphs, the range of three times  $\sigma_{pt}$  or  $\sqrt{\sigma_{pt}^2 + u^2(x_{pt})}$  is also shown by the horizontal dotted green lines. The codes of the labs are shown in the bottom horizontal axis whereas the techniques codes (including the relative colours employed already in this report, blue for XRF, red for NAA and grey for the other analytical techniques) are shown in the top horizontal axis.

For those element having more than 5 valid results but for which an assigned value was not available or could not be determined, in Figs. 94-99 a bar chart is shown reporting the results of the laboratories. The colour of the columns follows again the rules established for previous graphs.

For every participating laboratory its overall performance is presented in Figs. 100-169. The plots presented in this figure relate all the *Zeta*-scores and  $z$ - or  $z'$ -scores calculated for a given laboratory. Each result is marked as a circle, the different colour depending on whether  $z$ - or  $z'$ -score was considered. Also reported are the lines for  $Zeta$ -score = 3 and  $z$ - or  $z'$ -score = 3. They divide the plot area in four quadrants. The well performing laboratories would have more points located in the lower-left quadrant of the plot. If there are many points located in the upper-right quadrant, it suggests that these results do not fall in the defined range of acceptable results and, therefore, action should be taken to improve the performance of the analysis.

Table 5 summarizes for every participant the performance indicators. The number of results for which the performance indicators  $z$ - or  $z'$ -scores as well *Zeta*-scores are less than 3 are shown. The number of results for which the same indicators are equal or above 3 are also shown.

Please note that the sum of results derived from these columns can be lower than the total number of results submitted by the participant (second column) since for some elements the assigned value was not available and no performance indicator could be determined.

The overall performance for each participant is shown graphically in Figs. 170-173, reporting the box-and-whisker plots (defined below) for the  $z$ - and  $z'$ -scores and for the *R*-scores. The box-and-whisker plots for the  $z$ - and  $z'$ -scores are shown in Figs. 170 and 171, the latter with the vertical scale reduced to the range -5÷5. The box-and-whisker plots for the *R*-scores are reported in Figs. 172 and 173, the latter with the vertical scale reduced to the range 0÷2. Please note that some data might not been shown in Figs 170-173 since they lie out of the range of the scale reported in the graphs. The code of the participant is reported in the horizontal axis.

Given a set of data, a box-and-whisker plot is generated defining the following parameters:

- Median of the data set  $Q_2$
  - First quartile ( $Q_1$ ), the median of the lower half of the data set, including the median
  - Third quartile ( $Q_3$ ), the median of the upper half of the data set, including the median
- The quantity “interquartile range” ( $IQR$ ) is defined as  $IQR = Q_3 - Q_1$ . A data is considered an outlier (please note that this is a different definition of outlier from the one given in Section 3.3, and it is used only in this context for the box-and-whisker plots) when either it exceeds a distance of 1.5 times the  $IQR$  below the first quartile ( $Q_1 - 1.5 \cdot IQR$ ) or 1.5 times the  $IQR$  above the third quartile ( $Q_3 + 1.5 \cdot IQR$ ). In the graphs, the box represents the data in the range between  $Q_1$  and  $Q_3$ , whereas the median is shown as a horizontal line. The whiskers (vertical lines) extend from the ends of the box to the minimum value and maximum value that are not outliers. The single points out of the whiskers represent the outliers of the dataset.

The drawing below summarizes all the different parameters calculated for the creation of a box-and-whisker plot.

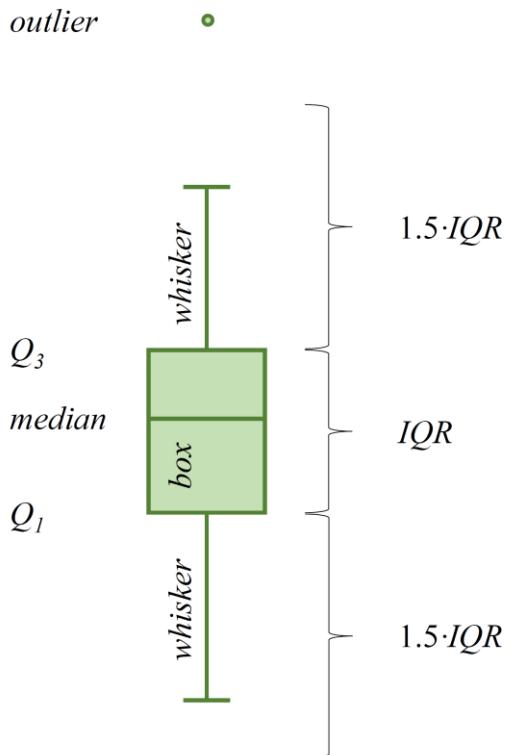


TABLE 4. SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE *Zeta*-SCORES AND THE *R*-SCORES FOR RESULTS IN THE [%] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	<i>Zeta</i> -score	<i>R</i> -score
Al ( $x_{pt} = 1.04$ , $\sigma_{pt} = 0.04$ , $u(x_{pt}) = 0.01$ ) [%]								
178	5.1	0.571*	0.017	2.98	-11.3	-	-24.0	0.55
151	7.2	0.78	0.005	0.64	-6.3	-	-24.0	0.75
172	5.2	0.94	0.04	4.26	-2.4	-	-2.4	0.90
105	1.3	0.96	0.043	4.48	-1.9	-	-1.8	0.92
152	5.2	0.972	0.012	1.23	-1.6	-	-4.4	0.93
183	5.4	0.98	0.018	1.84	-1.5	-	-2.9	0.94
176	5.2	0.994	0.018	1.81	-1.1	-	-2.3	0.96
74	2	1.01	0.005	0.50	-0.7	-	-2.8	0.97
182	5.1	1.02	0.179	17.55	-0.5	-	-0.1	0.98
232	5.1	1.045	0.064	6.12	0.1	-	0.1	1.00
215	5.1	1.052	0.07	6.65	0.3	-	0.2	1.01
124	1.2	1.068	0.009	0.84	0.7	-	2.1	1.03
116	1.3	1.08	0.12	11.11	1.0	-	0.3	1.04
94	1.2	1.08	0.02	1.85	1.0	-	1.8	1.04
217	5.1	1.137	0.02	1.76	2.3	-	4.4	1.09
199	5.1	1.18	0.032	2.71	3.4	-	4.2	1.13
197	5.1	1.21	0.02	1.65	4.1	-	7.7	1.16
227	2	1.23	0.018	1.46	4.6	-	9.3	1.18
194	5.1	1.24	0.15	12.10	4.8	-	1.3	1.19
234	5.4	1.25	0.19	15.20	5.1	-	1.1	1.20
221	5.2	1.27	0.09	7.09	5.6	-	2.5	1.22
130	2	1.32	0.38	28.79	6.8	-	0.7	1.27
219	5.2	1.468*	0.211	14.37	10.4	-	2.0	1.41
145	1.2	1.768*	0.005	0.28	17.6	-	67.3	1.70
77	1.2	1.88*	0.48	25.53	20.3	-	1.7	1.81
65	1.2	1.94*	0.29	14.95	21.8	-	3.1	1.87
204	1.2	1.983*	0.114	5.75	22.8	-	8.2	1.91
161	2	1.992*	0.16	8.03	23.0	-	5.9	1.92
202	5.1	2.26*	0.09	3.98	29.5	-	13.5	2.17
78	1.2	2.426*	0.084	3.46	33.5	-	16.4	2.33
231	1.2	2.45*	0.12	4.90	34.1	-	11.7	2.36
44	4.2	2.519*	0.312	12.39	35.8	-	4.7	2.42
93	2	2.549*	0.075	2.94	36.5	-	20.0	2.45
84	5.2	2.77*	0.05	1.81	41.8	-	34.0	2.66
126	1.2	2.79*	0.13	4.66	42.3	-	13.4	2.68
102	1.2	2.8*	0.03	1.07	42.6	-	55.9	2.69
230	1.2	2.9*	0.15	5.17	45.0	-	12.4	2.79
225	1.2	3.54*	0.55	15.54	60.5	-	4.5	3.40
85	1.2	3.9*	0.4	10.26	69.2	-	7.1	3.75
113	2	3.942*	0.014	0.36	70.2	-	171.0	3.79
68	1.2	4.87*	0.006	0.12	92.6	-	338.5	4.68
186	5.1	27.022**	1.96	7.25	628.3	-	13.3	25.98
C ( $x_{pt} = 5.33$ , $\sigma_{pt} = 0.17$ , $u(x_{pt}) = 0.06$ ) [%]								
234	5.4	3.26	0.13	3.99	-	-11.6	-14.3	0.61

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE *Zeta*-SCORES AND THE *R*-SCORES FOR RESULTS IN THE [%] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	<i>Zeta</i> -score	<i>R</i> -score
183	5.4	4.3	0.24	5.58	-	-5.8	-4.1	0.81
Ca ( $x_{pt} = 0.041$ , $\sigma_{pt} = 0.003$ , $u(x_{pt}) = 0.001$ ) [%]								
85	1.2	0.017	0.003	17.65	-	-8.3	-7.5	0.41
130	2	0.021	0.004	19.05	-	-6.9	-4.8	0.51
209	1.3	0.026	0.003	11.54	-	-5.2	-4.7	0.63
105	1.3	0.033	0.004	12.12	-	-2.8	-1.9	0.80
151	7.2	0.036	0.001	2.78	-	-1.7	-3.3	0.88
108	1.3	0.037	0.009	24.32	-	-1.4	-0.4	0.90
36	6.1	0.037	0.004	10.81	-	-1.4	-1.0	0.90
215	5.1	0.04	0.01	25.00	-	-0.3	-0.1	0.98
176	5.2	0.04	0.003	7.50	-	-0.3	-0.3	0.98
53	1.3	0.041	0.004	9.76	-	0.0	0.0	1.00
74	2	0.045	0.014	31.11	-	1.4	0.3	1.10
126	1.2	0.046	0.002	4.35	-	1.7	2.2	1.12
172	5.2	0.046	0.004	8.70	-	1.7	1.2	1.12
234	5.4	0.047	0.008	17.02	-	2.1	0.7	1.15
75	1.3	0.048	0.001	2.08	-	2.4	4.6	1.17
102	1.2	0.048	0.005	10.42	-	2.4	1.4	1.17
44	4.2	0.052	0.015	28.85	-	3.8	0.7	1.27
161	2	0.053	0.004	7.55	-	4.2	2.9	1.29
230	1.2	0.053	0.01	18.87	-	4.2	1.2	1.29
116	1.3	0.058	0.002	3.45	-	5.9	7.4	1.41
77	1.2	0.059	0.009	15.25	-	6.2	2.0	1.44
204	1.2	0.06	0.002	3.33	-	6.6	8.3	1.46
233	1.2	0.06	0.01	16.67	-	6.6	1.9	1.46
78	1.2	0.074	0.003	4.05	-	11.4	10.3	1.80
54	1.2	0.085	0.039	45.88	-	15.3	1.1	2.07
65	1.2	0.104*	0.009	8.65	-	21.8	6.9	2.54
94	1.2	0.111*	0.002	1.80	-	24.3	30.5	2.71
95	1.3	0.115*	0.003	2.61	-	25.7	23.1	2.80
225	1.2	0.15*	0.02	13.33	-	37.8	5.4	3.66
227	2	0.167*	0.01	5.99	-	43.7	12.5	4.07
129	1.2	0.201*	0.005	2.49	-	55.5	31.2	4.90
182	5.1	0.24*	0.017	7.08	-	69.0	11.7	5.85
113	2	0.287*	0.006	2.09	-	85.3	40.3	7.00
73	1.2	0.36*	0.012	3.33	-	110.6	26.5	8.78
68	1.2	0.55*	0.001	0.18	-	176.5	336.9	13.41
217	5.1	1.263**	0.02	1.58	-	423.8	61.0	30.80
145	1.2	9.167**	0.007	0.08	-	3164.7	1287.0	223.59
124	1.2	9.95**	0.138	1.39	-	3436.2	71.8	242.68
Fe ( $x_{pt} = 0.704$ , $\sigma_{pt} = 0.03$ , $u(x_{pt}) = 0.006$ ) [%]								
102	1.2	0.015**	0.001	6.67	-23.2	-	-114.0	0.02
36	6.1	0.42*	0.042	10.00	-9.6	-	-6.7	0.60
209	1.3	0.48	0.02	4.17	-7.5	-	-10.7	0.68
203	5.2	0.512	0.025	4.88	-6.5	-	-7.5	0.73
233	1.2	0.546	0.08	14.65	-5.3	-	-2.0	0.78
182	5.1	0.551	0.018	3.27	-5.2	-	-8.1	0.78

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE *Zeta*-SCORES AND THE *R*-SCORES FOR RESULTS IN THE [%] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	<i>Zeta</i> -score	<i>R</i> -score
75	1.3	0.558	0.001	0.18	-4.9	-	-24.2	0.79
89	1.2	0.573	0.02	3.49	-4.4	-	-6.3	0.81
234	5.4	0.592	0.09	15.20	-3.8	-	-1.2	0.84
232	5.1	0.6	0.036	6.00	-3.5	-	-2.9	0.85
183	5.4	0.6	0.01	1.67	-3.5	-	-8.9	0.85
74	2	0.61	0.02	3.28	-3.2	-	-4.5	0.87
105	1.3	0.617	0.026	4.21	-2.9	-	-3.3	0.88
227	2	0.631	0.004	0.63	-2.5	-	-10.2	0.90
54	1.2	0.636	0.065	10.22	-2.3	-	-1.0	0.90
95	1.3	0.638	0.017	2.66	-2.2	-	-3.7	0.91
192	5.2	0.647	0.015	2.32	-1.9	-	-3.5	0.92
228	5.2	0.65	0.018	2.77	-1.8	-	-2.8	0.92
176	5.2	0.661	0.01	1.51	-1.4	-	-3.7	0.94
172	5.2	0.67	0.03	4.48	-1.1	-	-1.1	0.95
191	5.2	0.67	0.06	8.96	-1.1	-	-0.6	0.95
171	5.1	0.67	0.016	2.39	-1.1	-	-2.0	0.95
178	5.1	0.678	0.028	4.13	-0.9	-	-0.9	0.96
154	7.1	0.68	0.014	2.06	-0.8	-	-1.6	0.97
215	5.1	0.694	0.042	6.05	-0.3	-	-0.2	0.99
175	5.2	0.694	0.022	3.17	-0.3	-	-0.4	0.99
152	5.2	0.701	0.051	7.28	-0.1	-	-0.1	1.00
217	5.1	0.712	0.07	9.83	0.3	-	0.1	1.01
194	5.1	0.718	0.068	9.47	0.5	-	0.2	1.02
94	1.2	0.72	0.01	1.39	0.5	-	1.4	1.02
221	5.2	0.72	0.04	5.56	0.5	-	0.4	1.02
55	5.2	0.722	0.017	2.35	0.6	-	1.0	1.03
219	5.2	0.728	0.028	3.85	0.8	-	0.8	1.03
186	5.1	0.737	0.021	2.85	1.1	-	1.5	1.05
202	5.1	0.74	0.01	1.35	1.2	-	3.1	1.05
196	5.2	0.745	0.08	10.74	1.4	-	0.5	1.06
124	1.2	0.758	0.017	2.24	1.8	-	3.0	1.08
230	1.2	0.76	0.08	10.53	1.9	-	0.7	1.08
130	2	0.77	0.002	0.26	2.2	-	10.5	1.09
199	5.1	0.773	0.017	2.20	2.3	-	3.8	1.10
116	1.3	0.783	0.037	4.73	2.7	-	2.1	1.11
184	5.2	0.86	0.03	3.49	5.3	-	5.1	1.22
197	5.1	0.87	0.02	2.30	5.6	-	8.0	1.24
79	1.2	0.912	0.07	7.68	7.0	-	3.0	1.30
149	5.2	0.943	0.015	1.59	8.1	-	14.8	1.34
231	1.2	0.98*	0.08	8.16	9.3	-	3.4	1.39
78	1.2	0.981*	0.075	7.65	9.3	-	3.7	1.39
108	1.3	1.009*	0.142	14.07	10.3	-	2.1	1.43
151	7.2	1.104*	0.007	0.63	13.5	-	43.5	1.57
129	1.2	1.14*	0.03	2.63	14.7	-	14.3	1.62
53	1.3	1.2*	0.1	8.33	16.7	-	5.0	1.70
204	1.2	1.239*	0.061	4.92	18.0	-	8.7	1.76
93	2	1.255*	0.055	4.38	18.6	-	10.0	1.78
39	1.2	1.32*	0.18	13.64	20.8	-	3.4	1.88
161	2	1.326*	0.026	1.96	21.0	-	23.3	1.88

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE *Zeta*-SCORES AND THE *R*-SCORES FOR RESULTS IN THE [%] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	<i>Zeta</i> -score	<i>R</i> -score
126	1.2	1.35*	0.006	0.44	21.8	-	76.4	1.92
44	4.2	1.388*	0.181	13.04	23.0	-	3.8	1.97
65	1.2	1.45*	0.11	7.59	25.1	-	6.8	2.06
225	1.2	1.48*	0.04	2.70	26.1	-	19.2	2.10
77	1.2	1.51*	0.009	0.60	27.2	-	74.7	2.14
145	1.2	1.618*	0.002	0.12	30.8	-	145.4	2.30
85	1.2	1.73*	0.3	17.34	34.6	-	3.4	2.46
68	1.2	2.7*	0.001	0.04	67.2	-	330.3	3.84
205	5.2	2.831*	0.747	26.39	71.7	-	2.8	4.02
73	1.2	3.38*	0.025	0.74	90.1	-	104.1	4.80
113	2	5.097*	0.015	0.29	148.0	-	272.2	7.24
$K$ ( $x_{pt} = 0.525$ , $\sigma_{pt} = 0.02$ , $u(x_{pt}) = 0.004$ ) [%]								
151	7.2	0.112*	0.001	0.89	-17.9	-	-98.3	0.21
89	1.2	0.187*	0.011	5.88	-14.6	-	-28.8	0.36
209	1.3	0.23*	0.04	17.39	-12.8	-	-7.3	0.44
129	1.2	0.275*	0.019	6.91	-10.8	-	-12.9	0.52
36	6.1	0.353	0.035	9.92	-7.4	-	-4.9	0.67
108	1.3	0.358	0.048	13.41	-7.2	-	-3.5	0.68
178	5.1	0.358	0.036	10.06	-7.2	-	-4.6	0.68
95	1.3	0.372	0.028	7.53	-6.6	-	-5.4	0.71
232	5.1	0.44	0.03	6.82	-3.7	-	-2.8	0.84
184	5.2	0.446	0.031	6.95	-3.4	-	-2.5	0.85
203	5.2	0.45	0.029	6.44	-3.2	-	-2.6	0.86
194	5.1	0.46	0.1	21.74	-2.8	-	-0.6	0.88
75	1.3	0.46	0.002	0.43	-2.8	-	-14.3	0.88
234	5.4	0.461	0.075	16.27	-2.8	-	-0.9	0.88
105	1.3	0.476	0.023	4.83	-2.1	-	-2.1	0.91
39	1.2	0.48	0.09	18.75	-1.9	-	-0.5	0.91
94	1.2	0.48	0.01	2.08	-1.9	-	-4.2	0.91
183	5.4	0.48	0.009	1.88	-1.9	-	-4.6	0.91
172	5.2	0.48	0.02	4.17	-1.9	-	-2.2	0.91
219	5.2	0.485	0.026	5.36	-1.7	-	-1.5	0.92
217	5.1	0.486	0.3	61.73	-1.7	-	-0.1	0.93
182	5.1	0.497	0.013	2.62	-1.2	-	-2.1	0.95
171	5.1	0.5	0.02	4.00	-1.1	-	-1.2	0.95
221	5.2	0.5	0.09	18.00	-1.1	-	-0.3	0.95
192	5.2	0.502	0.025	4.98	-1.0	-	-0.9	0.96
54	1.2	0.515	0.094	18.25	-0.4	-	-0.1	0.98
191	5.2	0.52	0.05	9.62	-0.2	-	-0.1	0.99
74	2	0.52	0.008	1.54	-0.2	-	-0.6	0.99
176	5.2	0.521	0.009	1.73	-0.2	-	-0.4	0.99
215	5.1	0.53	0.033	6.23	0.2	-	0.2	1.01
78	1.2	0.534	0.022	4.12	0.4	-	0.4	1.02
152	5.2	0.556	0.022	3.96	1.3	-	1.4	1.06
202	5.1	0.56	0.02	3.57	1.5	-	1.7	1.07
227	2	0.562	0.01	1.78	1.6	-	3.4	1.07
116	1.3	0.564	0.026	4.61	1.7	-	1.5	1.07
186	5.1	0.568	0.018	3.17	1.9	-	2.3	1.08

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [%] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	z-score	$z'$ -score	Zeta-score	R-score
55	5.2	0.574	0.017	2.96	2.1	-	2.8	1.09
197	5.1	0.58	0.01	1.72	2.4	-	5.1	1.10
233	1.2	0.586	0.18	30.72	2.6	-	0.3	1.12
124	1.2	0.611	0.008	1.31	3.7	-	9.6	1.16
199	5.1	0.62	0.036	5.81	4.1	-	2.6	1.18
84	5.2	0.7	0.01	1.43	7.6	-	16.2	1.33
230	1.2	0.7	0.07	10.00	7.6	-	2.5	1.33
225	1.2	0.73*	0.07	9.59	8.9	-	2.9	1.39
44	4.2	0.788*	0.128	16.24	11.4	-	2.1	1.50
231	1.2	0.81*	0.02	2.47	12.3	-	14.0	1.54
79	1.2	0.851*	0.102	11.99	14.1	-	3.2	1.62
93	2	0.86*	0.049	5.70	14.5	-	6.8	1.64
126	1.2	0.866*	0.04	4.62	14.7	-	8.5	1.65
161	2	0.899*	0.011	1.22	16.2	-	31.9	1.71
65	1.2	0.91*	0.008	0.88	16.6	-	42.9	1.73
145	1.2	0.949*	0.002	0.21	18.3	-	93.3	1.81
85	1.2	0.97*	0.1	10.31	19.2	-	4.4	1.85
204	1.2	0.974*	0.032	3.29	19.4	-	13.9	1.86
102	1.2	0.99*	0.11	11.11	20.1	-	4.2	1.89
77	1.2	1.11*	0.018	1.62	25.3	-	31.7	2.11
68	1.2	1.38*	0.001	0.07	37.0	-	203.4	2.63
205	5.2	1.828*	0.43	23.52	56.3	-	3.0	3.48
73	1.2	2.86*	0.035	1.22	100.9	-	66.3	5.45
113	2	4.079*	0.019	0.47	153.6	-	182.9	7.77
Na ( $x_{pt} = 0.136$ , $\sigma_{pt} = 0.007$ , $u(x_{pt}) = 0.003$ ) [%]								
130	2	0.003**	0.005	166.67	-	-16.9	-23.1	0.02
151	7.2	0.007**	0.001	14.29	-	-16.4	-42.5	0.05
178	5.1	0.075	0.003	4.00	-	-7.7	-14.7	0.55
161	2	0.103	0.027	26.21	-	-4.2	-1.2	0.76
36	6.1	0.107	0.011	10.28	-	-3.7	-2.6	0.79
183	5.4	0.112	0.003	2.68	-	-3.0	-5.8	0.82
203	5.2	0.12	0.007	5.83	-	-2.0	-2.1	0.88
191	5.2	0.12	0.01	8.33	-	-2.0	-1.5	0.88
124	1.2	0.125	0.009	7.20	-	-1.4	-1.2	0.92
232	5.1	0.125	0.008	6.40	-	-1.4	-1.3	0.92
227	2	0.128	0.012	9.38	-	-1.0	-0.6	0.94
219	5.2	0.13	0.005	3.85	-	-0.8	-1.0	0.96
85	1.2	0.13	0.04	30.77	-	-0.8	-0.1	0.96
192	5.2	0.131	0.007	5.34	-	-0.6	-0.7	0.96
172	5.2	0.132	0.005	3.79	-	-0.5	-0.7	0.97
175	5.2	0.133	0.005	3.76	-	-0.4	-0.5	0.98
176	5.2	0.133	0.002	1.50	-	-0.4	-0.9	0.98
194	5.1	0.133	0.022	16.54	-	-0.4	-0.1	0.98
234	5.4	0.133	0.015	11.28	-	-0.4	-0.2	0.98
84	5.2	0.136	0.003	2.21	-	0.0	0.0	1.00
171	5.1	0.136	0.003	2.21	-	0.0	0.0	1.00
186	5.1	0.143	0.003	2.10	-	0.9	1.7	1.05
152	5.2	0.143	0.005	3.50	-	0.9	1.2	1.05

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [%] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
55	5.2	0.145	0.001	0.69	-	1.1	3.0	1.07
215	5.1	0.146	0.01	6.85	-	1.3	1.0	1.07
217	5.1	0.147	0.002	1.36	-	1.4	3.1	1.08
184	5.2	0.15	0.05	33.33	-	1.8	0.3	1.10
202	5.1	0.152	0.004	2.63	-	2.0	3.3	1.12
221	5.2	0.16	0.01	6.25	-	3.0	2.3	1.18
199	5.1	0.16	0.002	1.25	-	3.0	6.9	1.18
197	5.1	0.169	0.002	1.18	-	4.2	9.4	1.24
93	2	0.215	0.026	12.09	-	10.0	3.0	1.58
204	1.2	0.236	0.028	11.86	-	12.7	3.6	1.74
113	2	0.238	0.011	4.62	-	12.9	9.0	1.75
65	1.2	0.24	0.043	17.92	-	13.2	2.4	1.76
137	1.2	0.243	0.05	20.58	-	13.6	2.1	1.79
44	4.2	0.244	0.072	29.51	-	13.7	1.5	1.79
126	1.2	0.32*	0.023	7.19	-	23.3	7.9	2.35
145	1.2	0.339*	0.011	3.24	-	25.7	17.9	2.49
231	1.2	0.35*	0.02	5.71	-	27.1	10.6	2.57
205	5.2	2.902**	0.02	0.69	-	350.8	136.9	21.34
Si ( $x_{pt} = 40.3$ , $\sigma_{pt} = 0.6$ , $u(x_{pt}) = 0.08$ ) [%]								
65	1.2	22.44*	1.57	7.00	-28.1	-	-11.4	0.56
137	1.2	24*	3.4	14.17	-25.7	-	-4.8	0.60
93	2	26.772*	0.222	0.83	-21.3	-	-57.5	0.66
105	1.3	28.69*	2.05	7.15	-18.3	-	-5.7	0.71
102	1.2	29.5*	3.3	11.19	-17.0	-	-3.3	0.73
124	1.2	29.9*	1.213	4.06	-16.4	-	-8.6	0.74
126	1.2	31.5*	0.05	0.16	-13.9	-	-94.7	0.78
78	1.2	32.578*	0.453	1.39	-12.2	-	-16.8	0.81
221	5.2	33.9*	3.5	10.32	-10.1	-	-1.8	0.84
231	1.2	34.1*	1.24	3.64	-9.8	-	-5.0	0.85
39	1.2	34.7*	2.8	8.07	-8.8	-	-2.0	0.86
234	5.4	34.9*	1.9	5.44	-8.5	-	-2.8	0.87
183	5.4	35*	0.5	1.43	-8.3	-	-10.5	0.87
145	1.2	35.96*	0.02	0.06	-6.8	-	-53.7	0.89
204	1.2	36.078*	0.698	1.93	-6.7	-	-6.0	0.90
161	2	36.448*	0.196	0.54	-6.1	-	-18.2	0.90
130	2	38.68	0.15	0.39	-2.6	-	-9.6	0.96
44	4.2	39.063	2.744	7.02	-1.9	-	-0.5	0.97
94	1.2	39.85	0.35	0.88	-0.7	-	-1.3	0.99
91	2	40.09	0.48	1.20	-0.3	-	-0.4	0.99
172	5.2	40.9	1.75	4.28	0.9	-	0.3	1.01
74	2	40.98	0.018	0.04	1.1	-	8.5	1.02
230	1.2	42.2	2.1	4.98	3.0	-	0.9	1.05
233	1.2	42.4	3.39	8.00	3.3	-	0.6	1.05
227	2	43.633*	0.116	0.27	5.3	-	23.8	1.08
176	5.2	43.9*	1	2.28	5.7	-	3.6	1.09
225	1.2	44.04*	2.87	6.52	5.9	-	1.3	1.09
77	1.2	44.57*	0.39	0.88	6.7	-	10.7	1.11
85	1.2	47.8*	5	10.46	11.8	-	1.5	1.19

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE *Zeta*-SCORES AND THE *R*-SCORES FOR RESULTS IN THE [%] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	<i>Zeta</i> -score	<i>R</i> -score
68	1.2	60.37*	0.04	0.07	31.6	-	228.2	1.50
73	1.2	81.67*	0.753	0.92	65.2	-	54.6	2.03
113	2	84.255*	0.073	0.09	69.2	-	410.5	2.09
Ti ( $x_{pt} = 0.109$ , $\sigma_{pt} = 0.006$ , $u(x_{pt}) = 0.001$ ) [%]								
151	7.2	0.061	0.001	1.64	-7.9	-	-30.6	0.56
89	1.2	0.072	0.002	2.78	-6.1	-	-15.8	0.66
178	5.1	0.076	0.015	19.74	-5.4	-	-2.2	0.70
209	1.3	0.083	0.008	9.64	-4.3	-	-3.2	0.76
75	1.3	0.086	0.001	1.16	-3.8	-	-14.7	0.79
152	5.2	0.089	0.004	4.49	-3.3	-	-4.8	0.82
108	1.3	0.093	0.017	18.28	-2.6	-	-0.9	0.85
233	1.2	0.093	0.02	21.51	-2.6	-	-0.8	0.85
183	5.4	0.094	0.002	2.13	-2.5	-	-6.4	0.86
95	1.3	0.096	0.012	12.50	-2.1	-	-1.1	0.88
194	5.1	0.098	0.009	9.18	-1.8	-	-1.2	0.90
232	5.1	0.099	0.007	7.07	-1.6	-	-1.4	0.91
234	5.4	0.1	0.005	5.00	-1.5	-	-1.7	0.92
105	1.3	0.1	0.011	11.00	-1.5	-	-0.8	0.92
221	5.2	0.1	0.009	9.00	-1.5	-	-1.0	0.92
172	5.2	0.101	0.005	4.95	-1.3	-	-1.6	0.93
91	2	0.104	0.005	4.81	-0.8	-	-1.0	0.95
124	1.2	0.104	0.015	14.42	-0.8	-	-0.3	0.95
182	5.1	0.104	0.003	2.88	-0.8	-	-1.5	0.95
215	5.1	0.105	0.008	7.62	-0.7	-	-0.5	0.96
227	2	0.105	0.004	3.81	-0.7	-	-1.0	0.96
74	2	0.106	0.002	1.89	-0.5	-	-1.3	0.97
54	1.2	0.106	0.019	17.92	-0.5	-	-0.2	0.97
176	5.2	0.107	0.003	2.80	-0.3	-	-0.6	0.98
197	5.1	0.11	0.03	27.27	0.2	-	0.0	1.01
94	1.2	0.112	0.002	1.79	0.5	-	1.3	1.03
199	5.1	0.114	0.012	10.53	0.8	-	0.4	1.05
116	1.3	0.117	0.006	5.13	1.3	-	1.3	1.07
202	5.1	0.118	0.003	2.54	1.5	-	2.8	1.08
192	5.2	0.134	0.01	7.46	4.1	-	2.5	1.23
53	1.3	0.14	0.01	7.14	5.1	-	3.1	1.28
230	1.2	0.14	0.03	21.43	5.1	-	1.0	1.28
79	1.2	0.148	0.007	4.73	6.4	-	5.5	1.36
129	1.2	0.15	0.006	4.00	6.7	-	6.7	1.38
44	4.2	0.164*	0.031	18.90	9.0	-	1.8	1.50
78	1.2	0.2*	0.016	8.00	15.0	-	5.7	1.83
161	2	0.215*	0.026	12.09	17.4	-	4.1	1.97
204	1.2	0.216*	0.005	2.31	17.6	-	20.8	1.98
93	2	0.217*	0.028	12.90	17.7	-	3.9	1.99
102	1.2	0.22*	0.02	9.09	18.2	-	5.5	2.02
137	1.2	0.225*	0.024	10.67	19.1	-	4.8	2.06
145	1.2	0.228*	0.001	0.44	19.6	-	75.9	2.09
225	1.2	0.23*	0.01	4.35	19.9	-	12.0	2.11
65	1.2	0.234*	0.002	0.85	20.5	-	53.5	2.15

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE *Zeta*-SCORES AND THE *R*-SCORES FOR RESULTS IN THE [%] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	<i>Zeta</i> -score	<i>R</i> -score
68	1.2	0.25*	0.002	0.80	23.2	-	60.4	2.29
85	1.2	0.264*	0.05	18.94	25.5	-	3.1	2.42
126	1.2	0.27*	0.001	0.37	26.5	-	102.7	2.48
231	1.2	0.33*	0.02	6.06	36.3	-	11.0	3.03
39	1.2	0.562*	0.11	19.57	74.4	-	4.1	5.16
73	1.2	0.591*	0.024	4.06	79.2	-	20.1	5.42
113	2	0.779*	0.016	2.05	110.1	-	41.8	7.15

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [mg/g] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
As ( $x_{pt} = 4.51$ , $\sigma_{pt} = 0.6$ , $u(x_{pt}) = 0.09$ ) [mg/kg]								
105	1.3	0.32**	0.032	10.00	-7.3	-	-44.1	0.07
203	5.2	3.27	0.19	5.81	-2.2	-	-5.9	0.73
232	5.1	3.86	0.23	5.96	-1.1	-	-2.6	0.86
75	1.3	3.91	0.22	5.63	-1.0	-	-2.5	0.87
176	5.2	3.94	0.06	1.52	-1.0	-	-5.3	0.87
192	5.2	3.97	0.2	5.04	-0.9	-	-2.5	0.88
175	5.2	4.035	0.138	3.42	-0.8	-	-2.9	0.89
172	5.2	4.1	0.16	3.90	-0.7	-	-2.2	0.91
182	5.1	4.11	0.25	6.08	-0.7	-	-1.5	0.91
171	5.1	4.2	0.26	6.19	-0.5	-	-1.1	0.93
191	5.2	4.2	0.4	9.52	-0.5	-	-0.8	0.93
228	5.2	4.2	0.6	14.29	-0.5	-	-0.5	0.93
84	5.2	4.3	0.3	6.98	-0.4	-	-0.7	0.95
55	5.2	4.31	0.41	9.51	-0.3	-	-0.5	0.96
152	5.2	4.353	0.364	8.36	-0.3	-	-0.4	0.97
161	2	4.6	1.5	32.61	0.2	-	0.1	1.02
217	5.1	4.64	0.07	1.51	0.2	-	1.1	1.03
215	5.1	4.7	0.34	7.23	0.3	-	0.5	1.04
219	5.2	4.74	1.071	22.59	0.4	-	0.2	1.05
194	5.1	4.76	0.6	12.61	0.4	-	0.4	1.06
199	5.1	4.79	0.39	8.14	0.5	-	0.7	1.06
202	5.1	4.9	0.13	2.65	0.7	-	2.5	1.09
197	5.1	4.99	0.1	2.00	0.8	-	3.6	1.11
221	5.2	5.07	0.33	6.51	1.0	-	1.6	1.12
186	5.1	5.073	0.535	10.55	1.0	-	1.0	1.12
178	5.1	5.28	1.14	21.59	1.3	-	0.7	1.17
184	5.2	5.49	0.19	3.46	1.7	-	4.7	1.22
126	1.2	5.5	0.6	10.91	1.7	-	1.6	1.22
85	1.2	6.3	1	15.87	3.1	-	1.8	1.40
151	7.2	6.745	0.255	3.78	3.9	-	8.3	1.50
94	1.2	7.6	0.9	11.84	5.4	-	3.4	1.69
74	2	10*	4.86	48.60	9.5	-	1.1	2.22
205	5.2	10.762*	1.309	12.16	10.9	-	4.8	2.39
227	2	16.405*	2.74	16.70	20.7	-	4.3	3.64
68	1.2	16.78*	0.14	0.83	21.3	-	73.8	3.72
137	1.2	17*	3.1	18.24	21.7	-	4.0	3.77
124	1.2	68.822**	3.149	4.58	111.8	-	20.4	15.26
113	2	107**	10.6	9.91	178.2	-	9.7	23.73
129	1.2	107.3**	28.19	26.27	178.7	-	3.6	23.79
Ba ( $x_{pt} = 128$ , $\sigma_{pt} = 10$ , $u(x_{pt}) = 1.4$ ) [mg/kg]								
154	7.1	8.97**	0.17	1.90	-12.1	-	-83.5	0.07
105	1.3	12**	3.7	30.83	-11.8	-	-29.3	0.09
151	7.2	26.082*	0.244	0.94	-10.3	-	-71.0	0.20
194	5.1	73.08	8.76	11.99	-5.6	-	-6.2	0.57

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [mg/g] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
75	1.3	85.97	2.1	2.44	-4.3	-	-16.6	0.67
203	5.2	105	11	10.48	-2.3	-	-2.1	0.82
182	5.1	107.3	18.78	17.50	-2.1	-	-1.1	0.84
85	1.2	111	10	9.01	-1.7	-	-1.7	0.87
192	5.2	113	6	5.31	-1.5	-	-2.4	0.88
79	1.2	113.26	7.311	6.46	-1.5	-	-2.0	0.88
202	5.1	114	14	12.28	-1.4	-	-1.0	0.89
232	5.1	115	10	8.70	-1.3	-	-1.3	0.90
215	5.1	118	8	6.78	-1.0	-	-1.2	0.92
176	5.2	120	3	2.50	-0.8	-	-2.4	0.94
39	1.2	120	22	18.33	-0.8	-	-0.4	0.94
217	5.1	121.3	2.6	2.14	-0.7	-	-2.3	0.95
175	5.2	123.009	7.204	5.86	-0.5	-	-0.7	0.96
197	5.1	125.9	1.85	1.47	-0.2	-	-0.9	0.98
191	5.2	126	20	15.87	-0.2	-	-0.1	0.98
233	1.2	129	34	26.36	0.1	-	0.0	1.01
172	5.2	130	6	4.62	0.2	-	0.3	1.02
171	5.1	132	5	3.79	0.4	-	0.8	1.03
221	5.2	135	20	14.81	0.7	-	0.3	1.05
152	5.2	136.553	7.935	5.81	0.9	-	1.1	1.07
184	5.2	140	14	10.00	1.2	-	0.9	1.09
126	1.2	140	7	5.00	1.2	-	1.7	1.09
199	5.1	140.85	12.3	8.73	1.3	-	1.0	1.10
74	2	163	18.28	11.21	3.5	-	1.9	1.27
130	2	165	28	16.97	3.8	-	1.3	1.29
204	1.2	191*	17	8.90	6.4	-	3.7	1.49
124	1.2	191.7*	16.03	8.36	6.5	-	4.0	1.50
145	1.2	195.5*	11.2	5.73	6.8	-	6.0	1.53
161	2	202.3*	21.3	10.53	7.5	-	3.5	1.58
65	1.2	204.04*	29.45	14.43	7.7	-	2.6	1.59
94	1.2	323*	8	2.48	19.8	-	24.0	2.52
77	1.2	669*	210	31.39	54.8	-	2.6	5.23
205	5.2	999.116*	4.373	0.44	88.3	-	189.5	7.81
$\text{Br} (x_{pt} = 24.2, \sigma_{pt} = 2, u(x_{pt}) = 0.4) [\text{mg/kg}]$								
204	1.2	0.254**	0.033	12.99	-10.0	-	-66.5	0.01
228	5.2	14*	5	35.71	-4.3	-	-2.0	0.58
124	1.2	15.6	0.645	4.13	-3.6	-	-11.7	0.64
89	1.2	16.529	0.62	3.75	-3.2	-	-10.7	0.68
77	1.2	17	1	5.88	-3.0	-	-6.8	0.70
232	5.1	19.2	1.2	6.25	-2.1	-	-4.0	0.79
233	1.2	19.4	6.4	32.99	-2.0	-	-0.7	0.80
209	1.3	19.4	0.2	1.03	-2.0	-	-11.7	0.80
221	5.2	20.7	1	4.83	-1.5	-	-3.3	0.86
54	1.2	21.946	3.108	14.16	-0.9	-	-0.7	0.91
191	5.2	22	2	9.09	-0.9	-	-1.1	0.91
182	5.1	22.15	0.64	2.89	-0.9	-	-2.8	0.92
137	1.2	22.2	2	9.01	-0.8	-	-1.0	0.92
176	5.2	22.2	0.3	1.35	-0.8	-	-4.3	0.92

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [mg/g] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
172	5.2	22.5	0.9	4.00	-0.7	-	-1.8	0.93
171	5.1	22.8	0.7	3.07	-0.6	-	-1.8	0.94
178	5.1	23	1.63	7.09	-0.5	-	-0.7	0.95
230	1.2	23.2	3.5	15.09	-0.4	-	-0.3	0.96
227	2	23.4	3.18	13.59	-0.3	-	-0.2	0.97
55	5.2	23.75	0.24	1.01	-0.2	-	-1.0	0.98
192	5.2	23.9	1.2	5.02	-0.1	-	-0.2	0.99
217	5.1	23.95	0.05	0.21	-0.1	-	-0.7	0.99
215	5.1	24	1.5	6.25	-0.1	-	-0.1	0.99
105	1.3	24	0.68	2.83	-0.1	-	-0.3	0.99
199	5.1	24.16	0.41	1.70	0.0	-	-0.1	1.00
95	1.3	24.39	1.9	7.79	0.1	-	0.1	1.01
194	5.1	24.8	2.78	11.21	0.3	-	0.2	1.02
94	1.2	26.6	0.7	2.63	1.0	-	3.1	1.10
184	5.2	26.6	0.82	3.08	1.0	-	2.7	1.10
152	5.2	27.453	0.116	0.42	1.4	-	8.6	1.13
197	5.1	27.69	0.4	1.44	1.5	-	6.5	1.14
186	5.1	28.685	0.545	1.90	1.9	-	6.9	1.19
202	5.1	28.9	0.8	2.77	2.0	-	5.4	1.19
161	2	36.5*	3.7	10.14	5.1	-	3.3	1.51
231	1.2	36.6*	4.31	11.78	5.2	-	2.9	1.51
65	1.2	40.47*	5.88	14.53	6.8	-	2.8	1.67
126	1.2	42.8*	2	4.67	7.8	-	9.2	1.77
79	1.2	48.12*	4.562	9.48	10.0	-	5.2	1.99
225	1.2	53.77*	6.06	11.27	12.3	-	4.9	2.22
44	4.2	63.689*	13.905	21.83	16.5	-	2.8	2.63
205	5.2	197.153*	0.26	0.13	72.2	-	390.4	8.15
113	2	213*	10	4.69	78.8	-	18.9	8.80
Cd ( $x_{pt} = 0.272$ , $\sigma_{pt} = 0.05$ , $u(x_{pt}) = 0.006$ ) [mg/kg]								
229	6.2	0.3	0.07	23.33	0.5	-	0.4	1.10
204	1.2	0.44	0.12	27.27	3.2	-	1.4	1.62
151	7.2	0.488	0.045	9.22	4.1	-	4.8	1.79
161	2	0.594	0.096	16.16	6.1	-	3.3	2.18
68	1.2	6.07**	0.56	9.23	109.5	-	10.4	22.32
234	5.4	9.27**	0.58	6.26	170.0	-	15.5	34.08
Ce ( $x_{pt} = 17.2$ , $\sigma_{pt} = 1.8$ , $u(x_{pt}) = 0.7$ ) [mg/kg]								
203	5.2	12.4	1.2	9.68	-	-2.5	-3.5	0.72
228	5.2	14	1.4	10.00	-	-1.7	-2.1	0.81
219	5.2	14.1	0.58	4.11	-	-1.6	-3.5	0.82
172	5.2	14.2	0.6	4.23	-	-1.6	-3.3	0.83
178	5.1	14.3	2.36	16.50	-	-1.5	-1.2	0.83
217	5.1	14.48	0.01	0.07	-	-1.4	-4.1	0.84
151	7.2	14.914	0.091	0.61	-	-1.2	-3.4	0.87
232	5.1	15.1	0.9	5.96	-	-1.1	-1.9	0.88
192	5.2	15.4	0.77	5.00	-	-0.9	-1.8	0.90
55	5.2	15.52	0.9	5.80	-	-0.9	-1.5	0.90
175	5.2	15.545	0.262	1.69	-	-0.9	-2.3	0.90

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [mg/g] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
215	5.1	15.8	1	6.33	-	-0.7	-1.2	0.92
191	5.2	16	2	12.50	-	-0.6	-0.6	0.93
194	5.1	16	1.006	6.29	-	-0.6	-1.0	0.93
221	5.2	16.6	1.4	8.43	-	-0.3	-0.4	0.97
152	5.2	16.71	0.689	4.12	-	-0.3	-0.5	0.97
184	5.2	16.9	0.57	3.37	-	-0.2	-0.3	0.98
171	5.1	17	1.3	7.65	-	-0.1	-0.1	0.99
202	5.1	17.03	1.37	8.04	-	-0.1	-0.1	0.99
149	5.2	19.89	1.11	5.58	-	1.4	2.1	1.16
233	1.2	20	4	20.00	-	1.5	0.7	1.16
197	5.1	20.23	0.8	3.95	-	1.6	2.9	1.18
199	5.1	21.27	1.89	8.89	-	2.1	2.0	1.24
105	1.3	25	1.6	6.40	-	4.1	4.5	1.45
77	1.2	27	13	48.15	-	5.1	0.8	1.57
204	1.2	31.9	5.2	16.30	-	7.7	2.8	1.85
205	5.2	54.772*	4.711	8.60	-	19.6	7.9	3.18
161	2	79.2*	4.4	5.56	-	32.4	13.9	4.60
Cl [mg/kg]								
68	1.2	22.27	0.02	0.09	-	-	-	-
234	5.4	70.3	3	4.27	-	-	-	-
176	5.2	81	8	9.88	-	-	-	-
172	5.2	82.8	4.6	5.56	-	-	-	-
183	5.4	83	1.3	1.57	-	-	-	-
215	5.1	96	9	9.38	-	-	-	-
194	5.1	104.38	21.35	20.45	-	-	-	-
105	1.3	126	35	27.78	-	-	-	-
191	5.2	128	14	10.94	-	-	-	-
182	5.1	128.4	11.43	8.90	-	-	-	-
178	5.1	137	37	27.01	-	-	-	-
197	5.1	161.95	4.16	2.57	-	-	-	-
152	5.2	171.368	4.244	2.48	-	-	-	-
227	2	207.8	35.32	17.00	-	-	-	-
126	1.2	307	15	4.89	-	-	-	-
161	2	319	16.2	5.08	-	-	-	-
44	4.2	329.279	67.764	20.58	-	-	-	-
113	2	1446**	86.96	6.01	-	-	-	-
Co ( $x_{pt} = 1.49$ , $\sigma_{pt} = 0.2$ , $u(x_{pt}) = 0.05$ ) [mg/kg]								
203	5.2	1.04	0.053	5.10	-2.0	-	-6.0	0.70
232	5.1	1.26	0.08	6.35	-1.0	-	-2.4	0.85
228	5.2	1.3	0.14	10.77	-0.8	-	-1.3	0.87
192	5.2	1.31	0.065	4.96	-0.8	-	-2.2	0.88
196	5.2	1.34	0.13	9.70	-0.7	-	-1.1	0.90
176	5.2	1.37	0.022	1.61	-0.5	-	-2.1	0.92
171	5.1	1.37	0.04	2.92	-0.5	-	-1.8	0.92
172	5.2	1.4	0.06	4.29	-0.4	-	-1.1	0.94
178	5.1	1.42	0.11	7.75	-0.3	-	-0.6	0.95
217	5.1	1.45	0.04	2.76	-0.2	-	-0.6	0.97

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [mg/g] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
215	5.1	1.48	0.1	6.76	0.0	-	-0.1	0.99
194	5.1	1.49	0.212	14.23	0.0	-	0.0	1.00
191	5.2	1.5	0.1	6.67	0.0	-	0.1	1.01
202	5.1	1.5	0.06	4.00	0.0	-	0.1	1.01
219	5.2	1.54	0.121	7.86	0.2	-	0.4	1.03
221	5.2	1.58	0.12	7.59	0.4	-	0.7	1.06
184	5.2	1.61	0.06	3.73	0.5	-	1.5	1.08
199	5.1	1.63	0.08	4.91	0.6	-	1.5	1.09
152	5.2	1.7	0.077	4.53	0.9	-	2.3	1.14
186	5.1	1.82	0.052	2.86	1.5	-	4.5	1.22
151	7.2	1.956	0.009	0.46	2.1	-	8.8	1.31
175	5.2	1.99	0.238	11.96	2.2	-	2.1	1.34
55	5.2	2.005	0.086	4.29	2.3	-	5.1	1.35
149	5.2	2.178	0.119	5.46	3.1	-	5.3	1.46
204	1.2	2.67	0.54	20.22	5.3	-	2.2	1.79
161	2	4.01*	0.79	19.70	11.2	-	3.2	2.69
77	1.2	5*	1	20.00	15.6	-	3.5	3.36
85	1.2	9.4*	1	10.64	35.2	-	7.9	6.31
205	5.2	9.883*	0.001	0.01	37.4	-	160.4	6.63
94	1.2	13*	0.3	2.31	51.3	-	37.8	8.72
Cr ( $x_{pt} = 81.9$ , $\sigma_{pt} = 7$ , $u(x_{pt}) = 1.0$ ) [mg/kg]								
205	5.2	8.274**	1.21	14.62	-10.9	-	-46.6	0.10
36	6.1	31*	3	9.68	-7.5	-	-16.1	0.38
221	5.2	56.1	4.6	8.20	-3.8	-	-5.5	0.68
203	5.2	61.1	2.4	3.93	-3.1	-	-8.0	0.75
154	7.1	64.8	1.3	2.01	-2.5	-	-10.4	0.79
152	5.2	68.977	4.602	6.67	-1.9	-	-2.7	0.84
233	1.2	71	16	22.54	-1.6	-	-0.7	0.87
182	5.1	71.43	3	4.20	-1.6	-	-3.3	0.87
75	1.3	71.45	1.63	2.28	-1.5	-	-5.4	0.87
228	5.2	72	7	9.72	-1.5	-	-1.4	0.88
124	1.2	72.5	3.309	4.56	-1.4	-	-2.7	0.89
192	5.2	73.5	3.7	5.03	-1.2	-	-2.2	0.90
227	2	77.328	11.986	15.50	-0.7	-	-0.4	0.94
89	1.2	79.176	4.79	6.05	-0.4	-	-0.6	0.97
95	1.3	80	14	17.50	-0.3	-	-0.1	0.98
130	2	81	14	17.28	-0.1	-	-0.1	0.99
172	5.2	82.3	3.3	4.01	0.1	-	0.1	1.00
94	1.2	83	2	2.41	0.2	-	0.5	1.01
232	5.1	85.7	5.2	6.07	0.6	-	0.7	1.05
219	5.2	85.716	3.034	3.54	0.6	-	1.2	1.05
191	5.2	86	9	10.47	0.6	-	0.5	1.05
176	5.2	86.2	1.3	1.51	0.6	-	2.6	1.05
175	5.2	86.712	3.531	4.07	0.7	-	1.3	1.06
215	5.1	87	6	6.90	0.8	-	0.8	1.06
74	2	87	5.56	6.39	0.8	-	0.9	1.06
171	5.1	87.2	2.3	2.64	0.8	-	2.1	1.06
229	6.2	88.11	4.64	5.27	0.9	-	1.3	1.08

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [mg/g] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
199	5.1	88.12	7.86	8.92	0.9	-	0.8	1.08
55	5.2	88.707	2.839	3.20	1.0	-	2.3	1.08
105	1.3	89	12	13.48	1.1	-	0.6	1.09
217	5.1	90.1	2.5	2.77	1.2	-	3.0	1.10
178	5.1	90.7	4.42	4.87	1.3	-	1.9	1.11
186	5.1	95.015	2.423	2.55	1.9	-	5.0	1.16
202	5.1	95.2	1.6	1.68	2.0	-	7.0	1.16
230	1.2	97	19	19.59	2.2	-	0.8	1.18
78	1.2	97.863	2.877	2.94	2.4	-	5.2	1.19
194	5.1	98.1	7.07	7.21	2.4	-	2.3	1.20
184	5.2	99	3.1	3.13	2.5	-	5.2	1.21
108	1.3	100	48	48.00	2.7	-	0.4	1.22
151	7.2	109.154	0.228	0.21	4.0	-	26.2	1.33
197	5.1	110.8	2.42	2.18	4.3	-	11.0	1.35
137	1.2	118	29	24.58	5.3	-	1.2	1.44
85	1.2	119	20	16.81	5.5	-	1.9	1.45
209	1.3	121	15	12.40	5.8	-	2.6	1.48
79	1.2	123.383	14.409	11.68	6.1	-	2.9	1.51
149	5.2	138.43*	3.433	2.48	8.4	-	15.8	1.69
126	1.2	152*	7	4.61	10.4	-	9.9	1.86
53	1.3	154*	15	9.74	10.7	-	4.8	1.88
231	1.2	157*	15.92	10.14	11.1	-	4.7	1.92
129	1.2	166.65*	31.07	18.64	12.6	-	2.7	2.03
65	1.2	178.12*	17.44	9.79	14.3	-	5.5	2.17
68	1.2	212.28*	2.22	1.05	19.3	-	53.4	2.59
204	1.2	217*	35	16.13	20.0	-	3.9	2.65
161	2	229.5*	14.2	6.19	21.9	-	10.4	2.80
234	2	259*	39	15.06	26.2	-	4.5	3.16
44	4.2	315.756*	72.814	23.06	34.6	-	3.2	3.86
77	1.2	519*	61	11.75	64.7	-	7.2	6.34
113	2	906**	4	0.44	122.1	-	199.7	11.06
$\text{Cu } (x_{pt} = 9.81, \sigma_{pt} = 1.1, u(x_{pt}) = 0.2) [\text{mg/kg}]$								
209	1.3	5.4	0.1	1.85	-4.0	-	-18.6	0.55
36	6.1	7.4	0.7	9.46	-2.2	-	-3.3	0.75
116	1.3	8.31	0.79	9.51	-1.3	-	-1.8	0.85
75	1.3	8.69	0.43	4.95	-1.0	-	-2.3	0.89
105	1.3	8.9	0.38	4.27	-0.8	-	-2.1	0.91
154	7.1	10.16	0.2	1.97	0.3	-	1.2	1.04
130	2	11	2	18.18	1.1	-	0.6	1.12
124	1.2	11.8	1.244	10.54	1.8	-	1.6	1.20
108	1.3	13	2	15.38	2.9	-	1.6	1.33
94	1.2	13	0.8	6.15	2.9	-	3.9	1.33
137	1.2	13.3	2	15.04	3.1	-	1.7	1.36
85	1.2	14	2	14.29	3.8	-	2.1	1.43
126	1.2	16	1	6.25	5.6	-	6.1	1.63
53	1.3	16	2	12.50	5.6	-	3.1	1.63
145	1.2	17.1	1.7	9.94	6.6	-	4.3	1.74
233	1.2	17.4	3.4	19.54	6.8	-	2.2	1.77

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [mg/g] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
204	1.2	19.5*	2.76	14.15	8.7	-	3.5	1.99
44	4.2	20.348*	4.664	22.92	9.5	-	2.3	2.07
229	6.2	21.91*	0.46	2.10	10.9	-	23.8	2.23
102	1.2	22*	2.7	12.27	11.0	-	4.5	2.24
68	1.2	22.6*	0.33	1.46	11.5	-	32.5	2.30
161	2	22.8*	4.5	19.74	11.7	-	2.9	2.32
65	1.2	22.97*	3.01	13.10	11.8	-	4.4	2.34
230	1.2	23.1*	3.5	15.15	11.9	-	3.8	2.35
78	1.2	23.122*	3.797	16.42	12.0	-	3.5	2.36
151	7.2	27.61*	0.131	0.47	16.0	-	70.8	2.81
227	2	28.855*	3.895	13.50	17.1	-	4.9	2.94
77	1.2	33*	5	15.15	20.8	-	4.6	3.36
231	1.2	37.4*	1.27	3.40	24.8	-	21.4	3.81
225	1.2	122.37*	15.42	12.60	101.1	-	7.3	12.47
39	1.2	125*	14	11.20	103.5	-	8.2	12.74
54	1.2	186.34*	19.022	10.21	158.6	-	9.3	18.99
89	1.2	1106.01**	29.4	2.66	985.0	-	37.3	112.74
F [mg/kg]								
234	5.4	58700	4700	8.01	-	-	-	-
La ( $x_{pt} = 8.2$ , $\sigma_{pt} = 1.0$ , $u(x_{pt}) = 0.3$ ) [mg/kg]								
203	5.2	6.51	0.51	7.83	-	-1.7	-2.8	0.79
232	5.1	6.85	0.41	5.99	-	-1.3	-2.6	0.84
219	5.2	7.37	0.351	4.76	-	-0.8	-1.8	0.90
178	5.1	7.48	0.37	4.95	-	-0.7	-1.5	0.91
217	5.1	7.507	0.07	0.93	-	-0.7	-2.2	0.92
182	5.1	7.62	0.3	3.94	-	-0.6	-1.3	0.93
172	5.2	7.62	0.31	4.07	-	-0.6	-1.3	0.93
151	7.2	7.683	0.079	1.03	-	-0.5	-1.6	0.94
191	5.2	7.7	0.7	9.09	-	-0.5	-0.7	0.94
175	5.2	7.93	0.07	0.88	-	-0.3	-0.8	0.97
176	5.2	7.96	0.12	1.51	-	-0.2	-0.7	0.97
215	5.1	7.98	0.49	6.14	-	-0.2	-0.4	0.97
192	5.2	8.17	0.41	5.02	-	0.0	-0.1	1.00
171	5.1	8.33	0.15	1.80	-	0.1	0.4	1.02
221	5.2	8.49	0.44	5.18	-	0.3	0.5	1.04
84	5.2	8.5	0.4	4.71	-	0.3	0.6	1.04
228	5.2	8.6	1.1	12.79	-	0.4	0.4	1.05
184	5.2	8.64	0.23	2.66	-	0.4	1.1	1.05
55	5.2	8.708	0.27	3.10	-	0.5	1.2	1.06
152	5.2	9.18	0.18	1.96	-	1.0	2.7	1.12
194	5.1	9.28	0.897	9.67	-	1.1	1.1	1.13
202	5.1	9.39	0.47	5.01	-	1.2	2.1	1.15
197	5.1	9.52	0.2	2.10	-	1.3	3.6	1.16
199	5.1	9.68	0.16	1.65	-	1.5	4.2	1.18
233	1.2	9.9	2	20.20	-	1.7	0.8	1.21
105	1.3	10	1.9	19.00	-	1.8	0.9	1.22
186	5.1	11.253	0.39	3.47	-	3.0	6.1	1.37

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [mg/g] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
130	2	12	4	33.33	-	3.8	0.9	1.46
204	1.2	13.44	1.92	14.29	-	5.2	2.7	1.64
205	5.2	31.164*	3.731	11.97	-	22.9	6.1	3.80
161	2	47.1*	5.4	11.46	-	38.7	7.2	5.74
77	1.2	56*	4	7.14	-	47.6	11.9	6.83
Li ( $x_{pt} = 9.33$ , $\sigma_{pt} = 1.1$ , $u(x_{pt}) = 0.17$ ) [mg/kg]								
154	7.1	1.27	0.02	1.57	-7.6	-	-46.3	0.14
36	6.1	11	1	9.09	1.6	-	1.6	1.18
Mg ( $x_{pt} = 340$ , $\sigma_{pt} = 20$ , $u(x_{pt}) = 9$ ) [mg/kg]								
36	6.1	231	23	9.96	-	-4.5	-4.4	0.68
130	2	355	87	24.51	-	0.6	0.2	1.04
227	2	385.95	54.998	14.25	-	1.9	0.8	1.14
215	5.1	405	83	20.49	-	2.7	0.8	1.19
151	7.2	423.179	1.899	0.45	-	3.4	9.4	1.24
172	5.2	430	83	19.30	-	3.7	1.1	1.26
161	2	547	44	8.04	-	8.6	4.6	1.61
204	1.2	565	39	6.90	-	9.3	5.6	1.66
85	1.2	614	100	16.29	-	11.3	2.7	1.81
84	5.2	740*	13	1.76	-	16.5	25.7	2.18
197	5.1	763.62*	82.23	10.77	-	17.5	5.1	2.25
44	4.2	777.137*	144.851	18.64	-	18.1	3.0	2.29
192	5.2	800*	60	7.50	-	19.0	7.6	2.35
65	1.2	975.63*	93.51	9.58	-	26.3	6.8	2.87
113	2	1107*	49.5	4.47	-	31.7	15.3	3.26
199	5.1	2067*	160	7.74	-	71.4	10.8	6.08
105	1.3	2690*	756	28.10	-	97.1	3.1	7.91
77	1.2	3625*	910	25.10	-	135.7	3.6	10.66
194	5.1	3922.5*	216.54	5.52	-	148.0	16.5	11.54
152	5.2	4218.405*	138.763	3.29	-	160.2	27.9	12.41
124	1.2	12390**	127.9	1.03	-	497.9	94.0	36.44
202	5.1	14438**	816	5.65	-	582.5	17.3	42.46
145	1.2	14980**	50	0.33	-	604.9	288.6	44.06
Mn ( $x_{pt} = 55.5$ , $\sigma_{pt} = 5$ , $u(x_{pt}) = 0.9$ ) [mg/kg]								
36	6.1	30	3	10.00	-5.3	-	-8.1	0.54
154	7.1	30.1	0.61	2.03	-5.2	-	-22.6	0.54
209	1.3	36	1	2.78	-4.0	-	-14.2	0.65
75	1.3	39.14	0.94	2.40	-3.4	-	-12.3	0.71
178	5.1	40	1.3	3.25	-3.2	-	-9.7	0.72
105	1.3	43	5.2	12.09	-2.6	-	-2.4	0.77
186	5.1	45.074	3.392	7.53	-2.1	-	-3.0	0.81
145	1.2	47	1	2.13	-1.8	-	-6.2	0.85
172	5.2	49.1	2	4.07	-1.3	-	-2.9	0.88
227	2	49.63	8.487	17.10	-1.2	-	-0.7	0.89
191	5.2	50	6	12.00	-1.1	-	-0.9	0.90
232	5.1	50.3	3.1	6.16	-1.1	-	-1.6	0.91
152	5.2	50.631	3.095	6.11	-1.0	-	-1.5	0.91

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [mg/g] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
194	5.1	51.45	4.01	7.79	-0.8	-	-1.0	0.93
108	1.3	52	21	40.38	-0.7	-	-0.2	0.94
55	5.2	53.698	1.772	3.30	-0.4	-	-0.9	0.97
183	5.4	54	1.2	2.22	-0.3	-	-1.0	0.97
192	5.2	54.7	3.3	6.03	-0.2	-	-0.2	0.99
202	5.1	56.4	3	5.32	0.2	-	0.3	1.02
221	5.2	56.9	5	8.79	0.3	-	0.3	1.03
215	5.1	57.6	3.5	6.08	0.4	-	0.6	1.04
229	6.2	57.95	8.5	14.67	0.5	-	0.3	1.04
84	5.2	58	0.5	0.86	0.5	-	2.3	1.05
94	1.2	58	0.8	1.38	0.5	-	2.0	1.05
116	1.3	58.02	4.33	7.46	0.5	-	0.6	1.05
199	5.1	58.75	2.62	4.46	0.7	-	1.2	1.06
176	5.2	61	1.1	1.80	1.1	-	3.8	1.10
182	5.1	62.39	1.75	2.80	1.4	-	3.5	1.12
130	2	63	12	19.05	1.5	-	0.6	1.14
233	1.2	63	16	25.40	1.5	-	0.5	1.14
151	7.2	68.405	0.356	0.52	2.7	-	12.8	1.23
219	5.2	69.396	14.43	20.79	2.9	-	1.0	1.25
197	5.1	70.27	0.64	0.91	3.0	-	13.0	1.27
230	1.2	73	11	15.07	3.6	-	1.6	1.32
89	1.2	77.951	3.76	4.82	4.6	-	5.8	1.40
44	4.2	81.259	21.152	26.03	5.3	-	1.2	1.46
225	1.2	82.55	26.39	31.97	5.6	-	1.0	1.49
78	1.2	85.6	1.764	2.06	6.2	-	15.0	1.54
204	1.2	86.3	8.6	9.97	6.3	-	3.6	1.55
161	2	87.3	5.1	5.84	6.6	-	6.1	1.57
85	1.2	89	10	11.24	6.9	-	3.3	1.60
126	1.2	90	9	10.00	7.1	-	3.8	1.62
234	2	102*	15	14.71	9.6	-	3.1	1.84
74	2	105*	20	19.05	10.2	-	2.5	1.89
53	1.3	108*	11	10.19	10.8	-	4.8	1.95
77	1.2	109*	16	14.68	11.0	-	3.3	1.96
231	1.2	113*	6.77	5.99	11.9	-	8.4	2.04
124	1.2	113.47*	3.498	3.08	12.0	-	16.0	2.04
102	1.2	113.6*	12.7	11.18	12.0	-	4.6	2.05
39	1.2	117*	24	20.51	12.7	-	2.6	2.11
79	1.2	128.537*	15.093	11.74	15.1	-	4.8	2.32
129	1.2	216.25*	50.17	23.20	33.1	-	3.2	3.90
113	2	276*	27.9	10.11	45.5	-	7.9	4.97
68	1.2	617.35**	1.05	0.17	115.8	-	398.0	11.12
Mo ( $x_{pt} = 4.58$ , $\sigma_{pt} = 0.6$ , $u(x_{pt}) = 0.10$ ) [mg/kg]								
105	1.3	2.5	0.73	29.20	-3.6	-	-2.8	0.55
204	1.2	3.25	0.87	26.77	-2.3	-	-1.5	0.71
137	1.2	3.85	0.85	22.08	-1.3	-	-0.9	0.84
221	5.2	4	0.4	10.00	-1.0	-	-1.4	0.87
199	5.1	4.11	0.09	2.19	-0.8	-	-3.5	0.90
217	5.1	4.12	0.08	1.94	-0.8	-	-3.6	0.90

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [mg/g] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
192	5.2	4.22	0.21	4.98	-0.6	-	-1.5	0.92
126	1.2	4.3	0.2	4.65	-0.5	-	-1.3	0.94
172	5.2	4.68	0.19	4.06	0.2	-	0.5	1.02
161	2	4.71	0.95	20.17	0.2	-	0.1	1.03
151	7.2	6.581	0.112	1.70	3.4	-	13.3	1.44
194	5.1	10.3*	0.62	6.02	9.8	-	9.1	2.25
68	1.2	31.52*	0.13	0.41	46.2	-	164.3	6.88
Nb ( $x_{pt} = 3.87$ , $\sigma_{pt} = 0.5$ , $u(x_{pt}) = 0.16$ ) [mg/kg]								
105	1.3	1.8	1.3	72.22	-	-3.9	-1.6	0.47
137	1.2	3.89	0.8	20.57	-	0.0	0.0	1.01
126	1.2	4.6	0.5	10.87	-	1.4	1.4	1.19
65	1.2	7.21	0.69	9.57	-	6.3	4.7	1.86
204	1.2	10.17*	1.18	11.60	-	11.9	5.3	2.63
161	2	11.5*	0.7	6.09	-	14.4	10.6	2.97
77	1.2	12*	4	33.33	-	15.4	2.0	3.10
68	1.2	19.08*	0.03	0.16	-	28.8	94.8	4.93
Ni ( $x_{pt} = 25.8$ , $\sigma_{pt} = 3$ , $u(x_{pt}) = 0.5$ ) [mg/kg]								
124	1.2	15.6	1.181	7.57	-4.0	-	-8.0	0.60
137	1.2	17.3	2.1	12.14	-3.4	-	-3.9	0.67
203	5.2	17.6	0.73	4.15	-3.2	-	-9.3	0.68
105	1.3	18	1.3	7.22	-3.1	-	-5.6	0.70
108	1.3	19	8	42.11	-2.7	-	-0.8	0.74
221	5.2	20.1	1.7	8.46	-2.3	-	-3.2	0.78
36	6.1	21	2	9.52	-1.9	-	-2.3	0.81
94	1.2	21.5	1.5	6.98	-1.7	-	-2.7	0.83
233	1.2	22	5	22.73	-1.5	-	-0.8	0.85
154	7.1	23	0.46	2.00	-1.1	-	-4.2	0.89
130	2	24	3	12.50	-0.7	-	-0.6	0.93
74	2	26	3.02	11.62	0.1	-	0.1	1.01
230	1.2	26.6	3.9	14.66	0.3	-	0.2	1.03
116	1.3	26.79	1.05	3.92	0.4	-	0.9	1.04
75	1.3	27.57	0.74	2.68	0.7	-	2.0	1.07
77	1.2	28	3	10.71	0.9	-	0.7	1.09
172	5.2	28.3	1.4	4.95	1.0	-	1.7	1.10
229	6.2	29.42	3.02	10.27	1.4	-	1.2	1.14
78	1.2	30.978	2.267	7.32	2.0	-	2.2	1.20
227	2	34.783	4.49	12.91	3.5	-	2.0	1.35
204	1.2	37.7	4.7	12.47	4.7	-	2.5	1.46
209	1.3	38	4	10.53	4.8	-	3.0	1.47
126	1.2	38	2	5.26	4.8	-	5.9	1.47
161	2	40.1	4.8	11.97	5.7	-	3.0	1.55
65	1.2	42.86	5.92	13.81	6.7	-	2.9	1.66
151	7.2	44.802	0.296	0.66	7.5	-	33.1	1.74
53	1.3	46	5	10.87	8.0	-	4.0	1.78
44	4.2	46.67*	7.34	15.73	8.2	-	2.8	1.81
85	1.2	51*	5	9.80	10.0	-	5.0	1.98
231	1.2	53.2*	5.73	10.77	10.8	-	4.8	2.06

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [mg/g] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
225	1.2	65.18*	13.76	21.11	15.6	-	2.9	2.53
113	2	243*	16.9	6.95	85.8	-	12.8	9.42
129	1.2	407.1**	54.87	13.48	150.7	-	6.9	15.78
$P (x_{pt} = 175, \sigma_{pt} = 13, u(x_{pt}) = 4) [\text{mg/kg}]$								
105	1.3	226	16	7.08	4.0	-	3.1	1.29
94	1.2	244	7	2.87	5.4	-	8.7	1.39
227	2	390.075*	36.608	9.38	16.7	-	5.8	2.23
85	1.2	481*	80	16.63	23.8	-	3.8	2.75
137	1.2	554*	48	8.66	29.5	-	7.9	3.17
204	1.2	603*	25.5	4.23	33.3	-	16.6	3.45
161	2	631*	70	11.09	35.4	-	6.5	3.61
65	1.2	650.54*	79.21	12.18	37.0	-	6.0	3.72
234	2	659*	99	15.02	37.6	-	4.9	3.77
78	1.2	731.889*	8.859	1.21	43.3	-	57.8	4.18
68	1.2	861.88*	4.85	0.56	53.4	-	111.6	4.93
126	1.2	885*	44	4.97	55.2	-	16.1	5.06
231	1.2	898*	47.97	5.34	56.2	-	15.0	5.13
75	1.3	946.22*	30.27	3.20	59.9	-	25.3	5.41
77	1.2	1218*	280	22.99	81.1	-	3.7	6.96
44	4.2	1477.858*	123.235	8.34	101.3	-	10.6	8.44
113	2	3040*	49	1.61	222.7	-	58.3	17.37
$Pb (x_{pt} = 19.6, \sigma_{pt} = 2, u(x_{pt}) = 0.3) [\text{mg/kg}]$								
68	1.2	8.17	0.13	1.59	-5.7	-	-37.2	0.42
154	7.1	10.22	0.21	2.05	-4.7	-	-26.9	0.52
124	1.2	14.36	0.925	6.44	-2.6	-	-5.4	0.73
74	2	14.5	3.83	26.41	-2.5	-	-1.3	0.74
130	2	15	4	26.67	-2.3	-	-1.1	0.77
75	1.3	16.85	0.38	2.26	-1.4	-	-5.8	0.86
89	1.2	18.304	0.857	4.68	-0.6	-	-1.4	0.93
137	1.2	18.4	6	32.61	-0.6	-	-0.2	0.94
233	1.2	19.4	4.8	24.74	-0.1	-	0.0	0.99
94	1.2	20.5	0.9	4.39	0.4	-	1.0	1.05
78	1.2	21.504	0.895	4.16	1.0	-	2.0	1.10
230	1.2	22	2.2	10.00	1.2	-	1.1	1.12
55	1.1	23.45	2.9	12.37	1.9	-	1.3	1.20
36	6.1	24	2	8.33	2.2	-	2.2	1.22
102	1.2	24	3	12.50	2.2	-	1.5	1.22
54	1.2	24.38	3.586	14.71	2.4	-	1.3	1.24
79	1.2	24.657	3.816	15.48	2.5	-	1.3	1.26
151	7.2	24.705	0.081	0.33	2.5	-	17.6	1.26
105	1.3	26	1.1	4.23	3.2	-	5.6	1.33
229	6.2	26.32	1.64	6.23	3.4	-	4.0	1.34
126	1.2	27.5	1	3.64	3.9	-	7.6	1.40
85	1.2	28.1	2	7.12	4.2	-	4.2	1.43
116	1.3	28.13	3.3	11.73	4.3	-	2.6	1.44
209	1.3	29	3	10.34	4.7	-	3.1	1.48
53	1.3	29	3	10.34	4.7	-	3.1	1.48

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE *Zeta*-SCORES AND THE *R*-SCORES FOR RESULTS IN THE [mg/g] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	<i>Zeta</i> -score	<i>R</i> -score
108	1.3	31	4	12.90	5.7	-	2.8	1.58
65	1.2	31.67*	3.25	10.26	6.0	-	3.7	1.62
95	1.3	32.5*	3.8	11.69	6.4	-	3.4	1.66
39	1.2	38*	7.4	19.47	9.2	-	2.5	1.94
161	2	48.7*	6.3	12.94	14.5	-	4.6	2.48
204	1.2	49.2*	5.1	10.37	14.8	-	5.8	2.51
145	1.2	52.4*	1.1	2.10	16.4	-	28.9	2.67
77	1.2	57*	5	8.77	18.7	-	7.5	2.91
225	1.2	91.04*	20.48	22.50	35.7	-	3.5	4.64
129	1.2	144.76*	36.64	25.31	62.5	-	3.4	7.39
Rb ( $x_{pt} = 24.7$ , $\sigma_{pt} = 2$ , $u(x_{pt}) = 0.3$ ) [mg/kg]								
151	7.2	13.762*	0.095	0.69	-4.5	-	-40.9	0.56
79	1.2	16.412	3.332	20.30	-3.4	-	-2.5	0.66
203	5.2	19.2	2.2	11.46	-2.3	-	-2.5	0.78
75	1.3	19.64	0.4	2.04	-2.1	-	-10.7	0.80
227	2	20.018	2.057	10.28	-1.9	-	-2.3	0.81
182	5.1	21.24	1.36	6.40	-1.4	-	-2.5	0.86
233	1.2	22	6	27.27	-1.1	-	-0.4	0.89
228	5.2	22.67	2.4	10.59	-0.8	-	-0.8	0.92
192	5.2	22.7	1.1	4.85	-0.8	-	-1.8	0.92
124	1.2	22.9	0.387	1.69	-0.7	-	-3.9	0.93
74	2	23	4.57	19.87	-0.7	-	-0.4	0.93
215	5.1	23.2	1.6	6.90	-0.6	-	-0.9	0.94
95	1.3	23.23	2.8	12.05	-0.6	-	-0.5	0.94
232	5.1	23.5	1.6	6.81	-0.5	-	-0.7	0.95
137	1.2	23.9	1.8	7.53	-0.3	-	-0.4	0.97
105	1.3	24	1.8	7.50	-0.3	-	-0.4	0.97
209	1.3	24	1	4.17	-0.3	-	-0.7	0.97
175	5.2	24.43	0.615	2.52	-0.1	-	-0.4	0.99
217	5.1	24.9	0.7	2.81	0.1	-	0.3	1.01
130	2	25	3	12.00	0.1	-	0.1	1.01
94	1.2	25	0.6	2.40	0.1	-	0.5	1.01
102	1.2	25	3.2	12.80	0.1	-	0.1	1.01
172	5.2	25.4	1.1	4.33	0.3	-	0.6	1.03
55	1.1	25.5	1.3	5.10	0.3	-	0.6	1.03
230	1.2	25.6	3.8	14.84	0.4	-	0.2	1.04
85	1.2	26	5	19.23	0.5	-	0.3	1.05
184	5.2	26.1	1.81	6.93	0.6	-	0.8	1.06
176	5.2	26.4	0.5	1.89	0.7	-	3.0	1.07
221	5.2	26.5	4.6	17.36	0.7	-	0.4	1.07
171	5.1	26.5	1	3.77	0.7	-	1.7	1.07
53	1.3	27	3	11.11	0.9	-	0.8	1.09
191	5.2	27	3	11.11	0.9	-	0.8	1.09
89	1.2	27.752	0.855	3.08	1.3	-	3.4	1.12
78	1.2	28.767	0.581	2.02	1.7	-	6.4	1.16
186	5.1	28.8	1.383	4.80	1.7	-	2.9	1.17
54	1.2	28.973	3.213	11.09	1.8	-	1.3	1.17
202	5.1	29.2	0.3	1.03	1.8	-	11.5	1.18

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [mg/g] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
116	1.3	29.51	2.85	9.66	2.0	-	1.7	1.19
194	5.1	30.1	4.8	15.95	2.2	-	1.1	1.22
152	5.2	30.593	1.43	4.67	2.4	-	4.1	1.24
108	1.3	31	5	16.13	2.6	-	1.3	1.26
126	1.2	33	1	3.03	3.4	-	8.1	1.34
68	1.2	34.12*	0.06	0.18	3.9	-	36.6	1.38
178	5.1	36.9*	5.85	15.85	5.0	-	2.1	1.49
161	2	38.3*	3.6	9.40	5.6	-	3.8	1.55
231	1.2	41.5*	3.52	8.48	6.9	-	4.8	1.68
204	1.2	42.3*	4.5	10.64	7.2	-	3.9	1.71
65	1.2	42.37*	4.22	9.96	7.2	-	4.2	1.72
77	1.2	44*	4	9.09	7.9	-	4.8	1.78
225	1.2	44.82*	6.1	13.61	8.3	-	3.3	1.81
205	5.2	86.022*	6.944	8.07	25.1	-	8.8	3.48
44	4.2	91.802*	15.016	16.36	27.5	-	4.5	3.72
113	2	200*	7.9	3.95	71.9	-	22.2	8.10
S [mg/kg]								
105	1.3	156	13	8.33	-	-	-	-
77	1.2	371	80	21.56	-	-	-	-
94	1.2	385	25	6.49	-	-	-	-
227	2	549.75	31.63	5.75	-	-	-	-
225	1.2	573.89	185.66	32.35	-	-	-	-
234	5.4	650	130	20.00	-	-	-	-
145	1.2	679.1	7.8	1.15	-	-	-	-
78	1.2	773.333	23.154	2.99	-	-	-	-
44	4.2	938.964	142.14	15.14	-	-	-	-
161	2	961	66	6.87	-	-	-	-
231	1.2	1038	82.13	7.91	-	-	-	-
204	1.2	1044	132	12.64	-	-	-	-
68	1.2	1083.28	1.4	0.13	-	-	-	-
126	1.2	1138	57	5.01	-	-	-	-
65	1.2	1396.05	92.41	6.62	-	-	-	-
113	2	4060	59.7	1.47	-	-	-	-
Sb ( $x_{pt} = 0.796$ , $\sigma_{pt} = 0.13$ , $u(x_{pt}) = 0.04$ ) [mg/kg]								
175	5.2	0.464	0.035	7.54	-2.5	-	-6.5	0.58
151	7.2	0.542	0.003	0.55	-1.9	-	-6.8	0.68
182	5.1	0.59	0.03	5.08	-1.6	-	-4.3	0.74
203	5.2	0.594	0.05	8.42	-1.5	-	-3.2	0.75
232	5.1	0.6	0.04	6.67	-1.5	-	-3.6	0.75
194	5.1	0.607	0.022	3.62	-1.4	-	-4.4	0.76
55	5.2	0.607	0.042	6.92	-1.4	-	-3.4	0.76
215	5.1	0.609	0.039	6.40	-1.4	-	-3.5	0.77
191	5.2	0.62	0.05	8.06	-1.3	-	-2.8	0.78
192	5.2	0.631	0.032	5.07	-1.3	-	-3.4	0.79
176	5.2	0.671	0.024	3.58	-0.9	-	-2.8	0.84
172	5.2	0.7	0.028	4.00	-0.7	-	-2.1	0.88
171	5.1	0.71	0.08	11.27	-0.7	-	-1.0	0.89

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [mg/g] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
217	5.1	0.72	0.05	6.94	-0.6	-	-1.2	0.90
152	5.2	0.724	0.055	7.60	-0.5	-	-1.1	0.91
178	5.1	0.81	0.1	12.35	0.1	-	0.1	1.02
186	5.1	0.815	0.075	9.20	0.1	-	0.2	1.02
204	1.2	0.82	0.23	28.05	0.2	-	0.1	1.03
221	5.2	0.839	0.112	13.35	0.3	-	0.4	1.05
196	5.2	0.854	0.12	14.05	0.4	-	0.5	1.07
199	5.1	0.88	0.07	7.95	0.6	-	1.1	1.11
184	5.2	0.93	0.03	3.23	1.0	-	2.8	1.17
197	5.1	1.03	0.1	9.71	1.8	-	2.2	1.29
149	5.2	1.076	0.13	12.08	2.1	-	2.1	1.35
205	5.2	1.737*	0.414	23.83	7.1	-	2.3	2.18
233	1.2	2.5*	0.69	27.60	12.9	-	2.5	3.14
161	2	8.12**	1.72	21.18	55.6	-	4.3	10.20
Sr ( $x_{pt} = 21.6$ , $\sigma_{pt} = 2$ , $u(x_{pt}) = 0.3$ ) [mg/kg]								
154	7.1	0.56**	0.01	1.79	-9.7	-	-73.7	0.03
151	7.2	7.916*	0.033	0.42	-6.3	-	-47.6	0.37
36	6.1	9*	0.9	10.00	-5.8	-	-13.3	0.42
75	1.3	15.51	0.48	3.09	-2.8	-	-10.9	0.72
209	1.3	17	3	17.65	-2.1	-	-1.5	0.79
203	5.2	18.9	3.2	16.93	-1.2	-	-0.8	0.88
227	2	19.363	2.096	10.82	-1.0	-	-1.1	0.90
53	1.3	20	2	10.00	-0.7	-	-0.8	0.93
105	1.3	20	1.5	7.50	-0.7	-	-1.0	0.93
192	5.2	20	1	5.00	-0.7	-	-1.5	0.93
130	2	21	4	19.05	-0.3	-	-0.1	0.97
233	1.2	21	6	28.57	-0.3	-	-0.1	0.97
230	1.2	22	3.3	15.00	0.2	-	0.1	1.02
95	1.3	22.38	1.86	8.31	0.4	-	0.4	1.04
199	5.1	22.778	1.2	5.27	0.5	-	1.0	1.05
74	2	23	2.2	9.57	0.6	-	0.6	1.06
89	1.2	23.059	0.777	3.37	0.7	-	1.8	1.07
221	5.2	23.6	2.5	10.59	0.9	-	0.8	1.09
176	5.2	24.6	1.5	6.10	1.4	-	2.0	1.14
108	1.3	25	8	32.00	1.6	-	0.4	1.16
55	1.1	25.2	1.6	6.35	1.7	-	2.2	1.17
78	1.2	25.667	0.633	2.47	1.9	-	5.9	1.19
54	1.2	26.387	3.07	11.63	2.2	-	1.6	1.22
79	1.2	26.845	3.188	11.88	2.4	-	1.6	1.24
126	1.2	27.2	1	3.68	2.6	-	5.4	1.26
94	1.2	27.5	0.9	3.27	2.7	-	6.2	1.27
68	1.2	27.9	0.02	0.07	2.9	-	22.0	1.29
85	1.2	28	2	7.14	2.9	-	3.2	1.30
161	2	28.14	4.45	15.81	3.0	-	1.5	1.30
215	5.1	28.4	6.2	21.83	3.1	-	1.1	1.31
172	5.2	30.5	7.6	24.92	4.1	-	1.2	1.41
102	1.2	32	3.9	12.19	4.8	-	2.7	1.48
124	1.2	32.101	0.49	1.53	4.8	-	18.5	1.49

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [mg/g] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
231	1.2	33.2*	3.04	9.16	5.3	-	3.8	1.54
65	1.2	34.43*	3.18	9.24	5.9	-	4.0	1.59
77	1.2	38*	4	10.53	7.5	-	4.1	1.76
225	1.2	40.2*	5.97	14.85	8.5	-	3.1	1.86
204	1.2	43.2*	4.1	9.49	9.9	-	5.3	2.00
44	4.2	48.477*	11.127	22.95	12.4	-	2.4	2.24
113	2	182*	8.7	4.78	73.7	-	18.4	8.43
Th ( $x_{pt} = 3.11$ , $\sigma_{pt} = 0.4$ , $u(x_{pt}) = 0.10$ ) [mg/kg]								
105	1.3	0.98	0.21	21.43	-5.1	-	-9.2	0.32
219	5.2	2.38	0.117	4.92	-1.7	-	-4.8	0.77
203	5.2	2.49	0.18	7.23	-1.5	-	-3.0	0.80
151	7.2	2.555	0.031	1.21	-1.3	-	-5.6	0.82
182	5.1	2.64	0.15	5.68	-1.1	-	-2.6	0.85
124	1.2	2.7	0.491	18.19	-1.0	-	-0.8	0.87
232	5.1	2.7	0.2	7.41	-1.0	-	-1.9	0.87
215	5.1	2.75	0.17	6.18	-0.9	-	-1.8	0.88
176	5.2	2.76	0.04	1.45	-0.8	-	-3.4	0.89
186	5.1	2.84	0.135	4.75	-0.6	-	-1.6	0.91
228	5.2	2.86	0.29	10.14	-0.6	-	-0.8	0.92
175	5.2	2.881	0.148	5.14	-0.5	-	-1.3	0.93
202	5.1	2.89	0.22	7.61	-0.5	-	-0.9	0.93
172	5.2	2.95	0.12	4.07	-0.4	-	-1.0	0.95
221	5.2	2.96	0.26	8.78	-0.4	-	-0.5	0.95
217	5.1	2.978	0.08	2.69	-0.3	-	-1.1	0.96
192	5.2	2.996	0.15	5.01	-0.3	-	-0.6	0.96
191	5.2	3	0.3	10.00	-0.3	-	-0.3	0.96
233	1.2	3	0.3	10.00	-0.3	-	-0.3	0.96
194	5.1	3.14	0.504	16.05	0.1	-	0.1	1.01
152	5.2	3.197	0.019	0.59	0.2	-	0.9	1.03
184	5.2	3.21	0.1	3.12	0.2	-	0.7	1.03
171	5.1	3.21	0.27	8.41	0.2	-	0.3	1.03
55	5.2	3.277	0.141	4.30	0.4	-	1.0	1.05
199	5.1	3.375	0.21	6.22	0.6	-	1.1	1.09
178	5.1	3.38	0.32	9.47	0.6	-	0.8	1.09
197	5.1	3.65	0.1	2.74	1.3	-	3.9	1.17
126	1.2	3.7	0.3	8.11	1.4	-	1.9	1.19
149	5.2	4.21	0.2	4.75	2.6	-	5.0	1.35
65	1.2	4.24	0.37	8.73	2.7	-	3.0	1.36
204	1.2	5.48	1.96	35.77	5.7	-	1.2	1.76
78	1.2	6.713*	0.372	5.54	8.6	-	9.4	2.16
205	5.2	9.23*	0.334	3.62	14.6	-	17.6	2.97
161	2	10.7*	1.6	14.95	18.1	-	4.7	3.44
77	1.2	17**	2	11.76	33.1	-	6.9	5.47
Tl ( $x_{pt} = 0.171$ , $\sigma_{pt} = 0.04$ , $u(x_{pt}) = 0.006$ ) [mg/kg]								
161	2	0.075	0.021	28.00	-2.7	-	-4.4	0.44
77	1.2	2149	91	4.23	60220.1	-	23.6	12567.25

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE *Zeta*-SCORES AND THE *R*-SCORES FOR RESULTS IN THE [mg/g] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	<i>Zeta</i> -score	<i>R</i> -score
$U$ ( $x_{pt} = 0.994$ , $\sigma_{pt} = 0.16$ , $u(x_{pt}) = 0.05$ ) [mg/kg]								
105	1.3	0.28	0.057	20.36	-	-4.3	-9.6	0.28
151	7.2	0.498	0.002	0.40	-	-3.0	-10.3	0.50
203	5.2	0.748	0.032	4.28	-	-1.5	-4.2	0.75
232	5.1	0.76	0.08	10.53	-	-1.4	-2.5	0.76
182	5.1	0.88	0.08	9.09	-	-0.7	-1.2	0.89
176	5.2	0.897	0.019	2.12	-	-0.6	-1.9	0.90
172	5.2	0.91	0.05	5.49	-	-0.5	-1.2	0.92
215	5.1	0.92	0.18	19.57	-	-0.4	-0.4	0.93
175	5.2	0.96	0.073	7.60	-	-0.2	-0.4	0.97
217	5.1	0.962	0.013	1.35	-	-0.2	-0.6	0.97
221	5.2	0.98	0.09	9.18	-	-0.1	-0.1	0.99
192	5.2	0.987	0.05	5.07	-	0.0	-0.1	0.99
152	5.2	1.043	0.086	8.25	-	0.3	0.5	1.05
199	5.1	1.047	0.11	10.51	-	0.3	0.4	1.05
191	5.2	1.1	0.1	9.09	-	0.6	1.0	1.11
184	5.2	1.1	0.07	6.36	-	0.6	1.2	1.11
171	5.1	1.11	0.14	12.61	-	0.7	0.8	1.12
194	5.1	1.15	0.077	6.70	-	0.9	1.7	1.16
65	1.2	2.31*	0.29	12.55	-	7.9	4.5	2.32
204	1.2	2.43*	0.23	9.47	-	8.6	6.1	2.44
205	5.2	3.199*	0.384	12.00	-	13.3	5.7	3.22
161	2	3.5*	0.7	20.00	-	15.1	3.6	3.52
77	1.2	62**	8	12.90	-	366.8	7.6	62.37
$V$ ( $x_{pt} = 14.3$ , $\sigma_{pt} = 1.5$ , $u(x_{pt}) = 0.3$ ) [mg/kg]								
68	1.2	4.97	0.05	1.01	-6.1	-	-35.6	0.35
178	5.1	8.07	0.72	8.92	-4.1	-	-8.1	0.56
75	1.3	12.65	1.73	13.68	-1.1	-	-0.9	0.88
152	5.2	12.84	0.648	5.05	-1.0	-	-2.1	0.90
232	5.1	13	0.8	6.15	-0.8	-	-1.5	0.91
172	5.2	13.4	0.6	4.48	-0.6	-	-1.4	0.94
199	5.1	13.42	0.8	5.96	-0.6	-	-1.0	0.94
192	5.2	13.5	1	7.41	-0.5	-	-0.8	0.94
182	5.1	13.63	0.5	3.67	-0.4	-	-1.2	0.95
176	5.2	13.8	0.3	2.17	-0.3	-	-1.3	0.97
194	5.1	13.88	1.76	12.68	-0.3	-	-0.2	0.97
217	5.1	14.8	1.2	8.11	0.3	-	0.4	1.03
124	1.2	15	1.2	8.00	0.5	-	0.6	1.05
215	5.1	15	1.1	7.33	0.5	-	0.6	1.05
55	5.2	15.138	1.786	11.80	0.5	-	0.5	1.06
221	5.2	15.5	1	6.45	0.8	-	1.2	1.08
191	5.2	16	2	12.50	1.1	-	0.8	1.12
202	5.1	16.2	0.9	5.56	1.2	-	2.0	1.13
197	5.1	16.23	0.47	2.90	1.3	-	3.6	1.13
130	2	17	8	47.06	1.8	-	0.3	1.19
94	1.2	17.2	1.5	8.72	1.9	-	1.9	1.20
105	1.3	18	1.4	7.78	2.4	-	2.6	1.26

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [mg/g] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
151	7.2	19.962	0.179	0.90	3.7	-	18.1	1.40
78	1.2	27.111*	2.235	8.24	8.4	-	5.7	1.90
65	1.2	31.58*	4.36	13.81	11.3	-	4.0	2.21
137	1.2	34.9*	3.9	11.17	13.4	-	5.3	2.44
161	2	36.3*	3.7	10.19	14.4	-	5.9	2.54
89	1.2	36.731*	6.54	17.81	14.6	-	3.4	2.57
204	1.2	38.6*	4.6	11.92	15.9	-	5.3	2.70
85	1.2	50.2*	5	9.96	23.4	-	7.2	3.51
233	1.2	53*	20	37.74	25.2	-	1.9	3.71
229	6.2	85.26*	15.38	18.04	46.3	-	4.6	5.96
$Y$ ( $x_{pt} = 6.64$ , $\sigma_{pt} = 0.8$ , $u(x_{pt}) = 0.19$ ) [mg/kg]								
230	1.2	5.7	1.1	19.30	-1.2	-	-0.8	0.86
233	1.2	6.6	2.1	31.82	-0.1	-	0.0	0.99
126	1.2	7	1	14.29	0.5	-	0.4	1.05
94	1.2	7	0.5	7.14	0.5	-	0.7	1.05
65	1.2	8.78	0.83	9.45	2.7	-	2.5	1.32
161	2	9.5	1.24	13.05	3.6	-	2.3	1.43
204	1.2	12.11*	2.89	23.86	6.8	-	1.9	1.82
102	1.2	15*	2.3	15.33	10.5	-	3.6	2.26
105	1.3	15*	1.1	7.33	10.5	-	7.5	2.26
225	1.2	15.69*	4.14	26.39	11.3	-	2.2	2.36
124	1.2	15.9*	0.875	5.50	11.6	-	10.4	2.39
77	1.2	16*	2	12.50	11.7	-	4.7	2.41
$Zr$ ( $x_{pt} = 216$ , $\sigma_{pt} = 15$ , $u(x_{pt}) = 3$ ) [mg/kg]								
39	1.2	55*	8	14.55	-10.5	-	-19.1	0.25
95	1.3	118.3*	26.2	22.15	-6.3	-	-3.7	0.55
203	5.2	153	23	15.03	-4.1	-	-2.7	0.71
176	5.2	159	3	1.89	-3.7	-	-14.1	0.74
227	2	175.925	2.511	1.43	-2.6	-	-10.9	0.81
124	1.2	180.1	9.807	5.45	-2.3	-	-3.5	0.83
192	5.2	192	10	5.21	-1.6	-	-2.3	0.89
233	1.2	195	56	28.72	-1.4	-	-0.4	0.90
130	2	200	28	14.00	-1.0	-	-0.6	0.93
171	5.1	200	11	5.50	-1.0	-	-1.4	0.93
102	1.2	203	22.8	11.23	-0.8	-	-0.6	0.94
137	1.2	215	26	12.09	-0.1	-	0.0	1.00
74	2	227	2.19	0.96	0.7	-	3.2	1.05
68	1.2	228.02	0.13	0.06	0.8	-	4.5	1.06
94	1.2	231.5	3.9	1.68	1.0	-	3.3	1.07
77	1.2	242	8	3.31	1.7	-	3.1	1.12
230	1.2	245	74	30.20	1.9	-	0.4	1.13
215	5.1	246	21	8.54	1.9	-	1.4	1.14
221	5.2	256	14	5.47	2.6	-	2.8	1.19
172	5.2	265	12	4.53	3.2	-	4.0	1.23
202	5.1	269	15	5.58	3.4	-	3.5	1.25
186	5.1	272.4	41.68	15.30	3.7	-	1.4	1.26
209	1.3	273	20	7.33	3.7	-	2.8	1.26

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE *Zeta*-SCORES AND THE *R*-SCORES FOR RESULTS IN THE [mg/g] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	<i>Zeta</i> -score	<i>R</i> -score
79	1.2	276.807	28.459	10.28	4.0	-	2.1	1.28
204	1.2	284	12	4.23	4.4	-	5.5	1.31
161	2	286	8.5	2.97	4.5	-	7.9	1.32
194	5.1	288	43.98	15.27	4.7	-	1.6	1.33
126	1.2	292	15	5.14	4.9	-	5.0	1.35
85	1.2	293	20	6.83	5.0	-	3.8	1.36
231	1.2	328*	23.02	7.02	7.3	-	4.8	1.52
199	5.1	336.05*	20	5.95	7.8	-	5.9	1.56
65	1.2	344.41*	31.75	9.22	8.3	-	4.0	1.59
54	1.2	345.398*	37.855	10.96	8.4	-	3.4	1.60
105	1.3	480*	26	5.42	17.2	-	10.1	2.22
234	2	534*	80	14.98	20.7	-	4.0	2.47
73	1.2	800*	20	2.50	38.0	-	28.9	3.70
113	2	1450*	9.5	0.66	80.2	-	125.0	6.71

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [ $\mu\text{g/g}$ ] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
Ag [ $\mu\text{g/kg}$ ]								
151	7.2	41.196**	2.945	7.15	-	-	-	-
221	5.2	551	51	9.26	-	-	-	-
204	1.2	3070	710	23.13	-	-	-	-
161	2	4110	1240	30.17	-	-	-	-
77	1.2	50000**	4000	8.00	-	-	-	-
B [ $\mu\text{g/kg}$ ]								
183	5.4	11200	100	0.89	-	-	-	-
Bi [ $\mu\text{g/kg}$ ]								
204	1.2	3990	560	14.04	-	-	-	-
$Cs (x_{pt} = 1280, \sigma_{pt} = 200, u(x_{pt}) = 70) [\mu\text{g/kg}]$								
196	5.2	84.9**	8	9.42	-	-5.7	-16.4	0.07
203	5.2	868	23	2.65	-	-2.0	-5.5	0.68
215	5.1	1010	70	6.93	-	-1.3	-2.7	0.79
192	5.2	1050	520	49.52	-	-1.1	-0.4	0.82
172	5.2	1068	46	4.31	-	-1.0	-2.5	0.83
175	5.2	1080	46.2	4.28	-	-1.0	-2.4	0.84
171	5.1	1080	40	3.70	-	-1.0	-2.4	0.84
191	5.2	1100	100	9.09	-	-0.9	-1.5	0.86
202	5.1	1116	18	1.61	-	-0.8	-2.2	0.87
221	5.2	1130	70	6.19	-	-0.7	-1.5	0.88
55	5.2	1147.9	66.578	5.80	-	-0.6	-1.4	0.90
186	5.1	1157.5	76.975	6.65	-	-0.6	-1.2	0.90
176	5.2	1191	19	1.60	-	-0.4	-1.2	0.93
151	7.2	1209.805	21.035	1.74	-	-0.3	-1.0	0.94
194	5.1	1220	95.6	7.84	-	-0.3	-0.5	0.95
152	5.2	1235	50.249	4.07	-	-0.2	-0.5	0.96
217	5.1	1274	30	2.35	-	0.0	-0.1	0.99
184	5.2	1300	80	6.15	-	0.1	0.2	1.01
199	5.1	1330.25	140	10.52	-	0.2	0.3	1.04
233	1.2	1380	460	33.33	-	0.5	0.2	1.08
232	5.1	1600	100	6.25	-	1.5	2.6	1.25
149	5.2	1648.2	169.5	10.28	-	1.7	2.0	1.29
178	5.1	1755	207	11.79	-	2.2	2.2	1.37
205	5.2	3797*	0.825	0.02	-	11.9	34.7	2.96
204	1.2	4300*	750	17.44	-	14.3	4.0	3.35
161	2	9770*	160	1.64	-	40.3	48.3	7.62
$Dy (x_{pt} = 1070, \sigma_{pt} = 170, u(x_{pt}) = 60) [\mu\text{g/kg}]$								
178	5.1	740	130	17.57	-	-1.9	-2.3	0.69
172	5.2	983	53	5.39	-	-0.5	-1.2	0.91
232	5.1	1000	100	10.00	-	-0.4	-0.6	0.93
192	5.2	1020	60	5.88	-	-0.3	-0.7	0.95

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [ $\mu\text{g/g}$ ] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
152	5.2	1022.667	51.694	5.05	-	-0.3	-0.7	0.95
215	5.1	1060	80	7.55	-	-0.1	-0.1	0.99
191	5.2	1100	100	9.09	-	0.1	0.2	1.02
202	5.1	1192	102	8.56	-	0.7	1.0	1.11
176	5.2	1220	60	4.92	-	0.8	1.7	1.14
197	5.1	1373	13.71	1.00	-	1.7	5.0	1.28
$Eu (x_{pt} = 204, \sigma_{pt} = 40, u(x_{pt}) = 7) [\mu\text{g/kg}]$								
151	7.2	161.723	0.077	0.05	-1.0	-	-5.7	0.79
217	5.1	166	2	1.20	-0.9	-	-4.9	0.81
197	5.1	173.16	8.17	4.72	-0.7	-	-2.8	0.85
215	5.1	182	11	6.04	-0.5	-	-1.7	0.89
186	5.1	186	14.5	7.80	-0.4	-	-1.1	0.91
172	5.2	189	9	4.76	-0.4	-	-1.3	0.93
184	5.2	190	10	5.26	-0.3	-	-1.1	0.93
191	5.2	190	20	10.53	-0.3	-	-0.7	0.93
171	5.1	193	5	2.59	-0.3	-	-1.3	0.94
203	5.2	194	12	6.19	-0.2	-	-0.7	0.95
178	5.1	196	37	18.88	-0.2	-	-0.2	0.96
182	5.1	200	10	5.00	-0.1	-	-0.3	0.98
202	5.1	203	9.2	4.53	0.0	-	-0.1	0.99
192	5.2	203	10	4.93	0.0	-	-0.1	0.99
175	5.2	203.32	15.02	7.39	0.0	-	-0.1	1.00
194	5.1	214	21.4	10.00	0.2	-	0.4	1.05
199	5.1	221.975	19	8.56	0.4	-	0.9	1.09
176	5.2	222	4	1.80	0.4	-	2.1	1.09
149	5.2	231.1	28.4	12.29	0.6	-	0.9	1.13
152	5.2	237.5	14.79	6.23	0.8	-	2.0	1.16
221	5.2	247	43	17.41	1.0	-	1.0	1.21
232	5.1	370*	20	5.41	4.0	-	7.8	1.81
205	5.2	1035*	2.726	0.26	20.0	-	104.2	5.07
Ga [ $\mu\text{g/kg}$ ]								
65	1.2	7.32**	1.01	13.80	-	-	-	-
232	5.1	2600	210	8.08	-	-	-	-
194	5.1	2990	188.76	6.31	-	-	-	-
182	5.1	3100	180	5.81	-	-	-	-
105	1.3	3100	750	24.19	-	-	-	-
202	5.1	3222	63	1.96	-	-	-	-
215	5.1	3375	850	25.19	-	-	-	-
53	1.3	3692	738	19.99	-	-	-	-
124	1.2	3800	424.26	11.16	-	-	-	-
151	7.2	4257.142	37.143	0.87	-	-	-	-
161	2	4800	900	18.75	-	-	-	-
204	1.2	5020	810	16.14	-	-	-	-
126	1.2	5700	1000	17.54	-	-	-	-
78	1.2	6698	484	7.23	-	-	-	-
94	1.2	7400	900	12.16	-	-	-	-
77	1.2	21000	5000	23.81	-	-	-	-

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [ $\mu\text{g/g}$ ] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
Gd [ $\mu\text{g/kg}$ ]								
176	5.2	800	30	3.75	-	-	-	-
234	5.4	851	84	9.87	-	-	-	-
192	5.2	1090	80	7.34	-	-	-	-
183	5.4	1200	100	8.33	-	-	-	-
Ge [ $\mu\text{g/kg}$ ]								
105	1.3	810	110	13.58	-	-	-	-
204	1.2	2050	460	22.44	-	-	-	-
77	1.2	14000	3000	21.43	-	-	-	-
$Hf(x_{pt} = 6010, \sigma_{pt} = 700, u(x_{pt}) = 190)$ [ $\mu\text{g/kg}$ ]								
65	1.2	2.81**	0.25	8.90	-8.2	-	-31.6	0.00
186	5.1	4948	165.76	3.35	-1.5	-	-4.2	0.82
55	5.2	5322.633	127.743	2.40	-0.9	-	-3.0	0.88
203	5.2	5330	315	5.91	-0.9	-	-1.9	0.89
217	5.1	5343	70	1.31	-0.9	-	-3.3	0.89
192	5.2	5470	270	4.94	-0.7	-	-1.6	0.91
178	5.1	5480	470	8.58	-0.7	-	-1.1	0.91
152	5.2	5485	665.301	12.13	-0.7	-	-0.8	0.91
191	5.2	5600	700	12.50	-0.6	-	-0.6	0.93
232	5.1	5600	370	6.61	-0.6	-	-1.0	0.93
194	5.1	5610	592.778	10.57	-0.6	-	-0.6	0.93
105	1.3	5700	990	17.37	-0.4	-	-0.3	0.95
176	5.2	5790	90	1.55	-0.3	-	-1.1	0.96
202	5.1	5797	214	3.69	-0.3	-	-0.8	0.96
175	5.2	5994	538	8.98	0.0	-	0.0	1.00
215	5.1	6190	420	6.79	0.2	-	0.4	1.03
172	5.2	6275	252	4.02	0.4	-	0.8	1.04
184	5.2	6340	200	3.15	0.4	-	1.2	1.05
221	5.2	6370	470	7.38	0.5	-	0.7	1.06
171	5.1	6630	170	2.56	0.8	-	2.4	1.10
197	5.1	6779.98	208.01	3.07	1.0	-	2.7	1.13
126	1.2	6900	1400	20.29	1.2	-	0.6	1.15
149	5.2	7633.2	138.8	1.82	2.2	-	6.9	1.27
199	5.1	7641	436.811	5.72	2.2	-	3.4	1.27
205	5.2	8108	0.489	0.01	2.9	-	11.0	1.35
$Hg(x_{pt} = 51.2, \sigma_{pt} = 11, u(x_{pt}) = 1.0)$ [ $\mu\text{g/kg}$ ]								
55	6.4	56.146	3.54	6.30	0.4	-	1.3	1.10
161	2	69	12	17.39	1.6	-	1.5	1.35
204	1.2	400*	90	22.50	31.0	-	3.9	7.81
126	1.2	500*	100	20.00	39.8	-	4.5	9.77
234	5.4	2950*	292	9.90	257.4	-	9.9	57.62
Ho [ $\mu\text{g/kg}$ ]								
192	5.2	208	10	4.81	-	-	-	-

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [ $\mu\text{g/g}$ ] RANGE.

Participant code	Technique code	Measurand mass fraction		Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
234	5.4	12200		2600	21.31	-	-	-	-
I [ $\mu\text{g/kg}$ ]									
172	5.2	7114		325	4.57	-	-	-	-
192	5.2	7730		450	5.82	-	-	-	-
221	5.2	7730		1310	16.95	-	-	-	-
182	5.1	7730		650	8.41	-	-	-	-
215	5.1	8360		820	9.81	-	-	-	-
197	5.1	9751.03		233.94	2.40	-	-	-	-
161	2	17700		3100	17.51	-	-	-	-
204	1.2	44700		3900	8.72	-	-	-	-
$Lu (x_{pt} = 136, \sigma_{pt} = 30, u(x_{pt}) = 8) [\mu\text{g/kg}]$									
203	5.2	95.4		7.4	7.76	-1.4	-	-3.8	0.70
171	5.1	118		10	8.47	-0.6	-	-1.4	0.87
176	5.2	118		6	5.08	-0.6	-	-1.8	0.87
215	5.1	129		21	16.28	-0.2	-	-0.3	0.95
192	5.2	130		7	5.38	-0.2	-	-0.6	0.95
152	5.2	137.5		4.33	3.15	0.0	-	0.1	1.01
232	5.1	140		10	7.14	0.1	-	0.3	1.03
184	5.2	150		10	6.67	0.5	-	1.1	1.10
191	5.2	150		20	13.33	0.5	-	0.6	1.10
199	5.1	154.7		10.23	6.61	0.6	-	1.4	1.14
175	5.2	166.5		19.6	11.77	1.0	-	1.4	1.22
$Nd (x_{pt} = 7200, \sigma_{pt} = 900, u(x_{pt}) = 500) [\mu\text{g/kg}]$									
65	1.2	14.38**		1.24	8.62	-	-7.2	-13.7	0.00
172	5.2	5346		237	4.43	-	-1.8	-3.2	0.75
175	5.2	5967		791	13.26	-	-1.2	-1.3	0.83
233	1.2	6000		1900	31.67	-	-1.2	-0.6	0.84
217	5.1	6350		320	5.04	-	-0.8	-1.3	0.89
152	5.2	6525		55	0.84	-	-0.6	-1.2	0.91
171	5.1	6720		620	9.23	-	-0.4	-0.5	0.94
192	5.2	6730		340	5.05	-	-0.4	-0.7	0.94
215	5.1	6980		760	10.89	-	-0.2	-0.2	0.97
199	5.1	7075.667		800	11.31	-	-0.1	-0.1	0.99
221	5.2	7660		1370	17.89	-	0.5	0.3	1.07
204	1.2	8950		1270	14.19	-	1.8	1.3	1.25
205	5.2	28515*		2.9	0.01	-	21.4	40.9	3.98
161	2	32800*		4200	12.80	-	25.7	6.1	4.58
Pd [ $\mu\text{g/kg}$ ]									
68	1.2	0.004		0.001	25.00	-	-	-	-
Pr [ $\mu\text{g/kg}$ ]									
172	5.2	1590		124	7.80	-	-	-	-
233	1.2	6700		1500	22.39	-	-	-	-

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [ $\mu\text{g/g}$ ] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
Ru [ $\mu\text{g/kg}$ ]								
172	5.2	3401	141	4.15	-	-	-	-
$Sc (x_{pt} = 1320, \sigma_{pt} = 200, u(x_{pt}) = 60) [\mu\text{g/kg}]$								
65	1.2	3.47**	0.3	8.65	-6.5	-	-22.1	0.00
204	1.2	460	130	28.26	-4.2	-	-6.0	0.35
203	5.2	963	47	4.88	-1.8	-	-4.7	0.73
182	5.1	970	30	3.09	-1.7	-	-5.2	0.74
219	5.2	1120.892	48.65	4.34	-1.0	-	-2.6	0.85
232	5.1	1130	70	6.19	-0.9	-	-2.0	0.86
178	5.1	1140	43	3.77	-0.9	-	-2.4	0.87
192	5.2	1160	60	5.17	-0.8	-	-1.9	0.88
171	5.1	1180	30	2.54	-0.7	-	-2.1	0.90
228	5.2	1180	120	10.17	-0.7	-	-1.0	0.90
172	5.2	1193	48	4.02	-0.6	-	-1.6	0.91
191	5.2	1200	100	8.33	-0.6	-	-1.0	0.91
175	5.2	1220	33.6	2.75	-0.5	-	-1.4	0.93
176	5.2	1221	18	1.47	-0.5	-	-1.6	0.93
215	5.1	1230	80	6.50	-0.4	-	-0.9	0.93
217	5.1	1230	34	2.76	-0.4	-	-1.3	0.93
194	5.1	1280	125.5	9.80	-0.2	-	-0.3	0.97
55	5.2	1280.2	12.802	1.00	-0.2	-	-0.6	0.97
152	5.2	1330	67.454	5.07	0.1	-	0.1	1.01
202	5.1	1341	51	3.80	0.1	-	0.3	1.02
186	5.1	1357.5	29.865	2.20	0.2	-	0.6	1.03
196	5.2	1380	100	7.25	0.3	-	0.5	1.05
184	5.2	1400	30	2.14	0.4	-	1.2	1.06
221	5.2	1460	100	6.85	0.7	-	1.2	1.11
199	5.1	1535.75	32.892	2.14	1.1	-	3.2	1.17
197	5.1	1558.6	32.24	2.07	1.2	-	3.6	1.18
149	5.2	1724.6	42.6	2.47	2.0	-	5.6	1.31
151	7.2	1990.407	37.165	1.87	3.3	-	9.6	1.51
161	2	7860*	1250	15.90	32.4	-	5.2	5.97
205	5.2	8906*	0.168	0.00	37.5	-	127.6	6.76
137	1.2	11333*	3031	26.74	49.5	-	3.3	8.60
Se [ $\mu\text{g/kg}$ ]								
203	5.2	331	30	9.06	-	-	-	-
192	5.2	334	28	8.38	-	-	-	-
204	1.2	416	143	34.38	-	-	-	-
176	5.2	460	30	6.52	-	-	-	-
221	5.2	478	110	23.01	-	-	-	-
126	1.2	800	200	25.00	-	-	-	-
233	1.2	1300	350	26.92	-	-	-	-
151	7.2	3384.827	599.602	17.71	-	-	-	-
161	2	7800**	900	11.54	-	-	-	-

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [ $\mu\text{g/g}$ ] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
<i>Sm (<math>x_{pt} = 1230</math>, <math>\sigma_{pt} = 190</math>, <math>u(x_{pt}) = 40</math>) [<math>\mu\text{g/kg}</math>]</i>								
203	5.2	973	108	11.10	-1.3	-	-2.2	0.79
217	5.1	1011	32	3.17	-1.1	-	-4.0	0.82
84	5.2	1030	250	24.27	-1.0	-	-0.8	0.84
232	5.1	1070	60	5.61	-0.8	-	-2.1	0.87
182	5.1	1080	120	11.11	-0.8	-	-1.2	0.88
151	7.2	1090.151	17.57	1.61	-0.7	-	-2.9	0.89
175	5.2	1105	174	15.75	-0.6	-	-0.7	0.90
202	5.1	1107	113	10.21	-0.6	-	-1.0	0.90
176	5.2	1113	16	1.44	-0.6	-	-2.5	0.91
183	5.4	1120	20	1.79	-0.6	-	-2.2	0.91
234	5.4	1130	70	6.19	-0.5	-	-1.2	0.92
55	5.2	1162.1	19.756	1.70	-0.3	-	-1.4	0.95
152	5.2	1176.667	94.281	8.01	-0.3	-	-0.5	0.96
172	5.2	1185	48	4.05	-0.2	-	-0.7	0.97
215	5.1	1190	80	6.72	-0.2	-	-0.4	0.97
178	5.1	1210	75	6.20	-0.1	-	-0.2	0.99
186	5.1	1244	180	14.47	0.1	-	0.1	1.01
171	5.1	1260	70	5.56	0.2	-	0.4	1.03
191	5.2	1300	100	7.69	0.4	-	0.7	1.06
221	5.2	1300	310	23.85	0.4	-	0.2	1.06
199	5.1	1312.65	73.84	5.63	0.4	-	1.0	1.07
192	5.2	1330	70	5.26	0.5	-	1.2	1.08
184	5.2	1350	40	2.96	0.6	-	2.1	1.10
194	5.1	1510	145.56	9.64	1.5	-	1.9	1.23
233	1.2	1700	340	20.00	2.5	-	1.4	1.39
197	5.1	1818.46	24.08	1.32	3.1	-	11.9	1.48
205	5.2	5167*	2.368	0.05	20.7	-	90.3	4.21
161	2	5420*	530	9.78	22.0	-	7.9	4.42
<i>Sn [<math>\mu\text{g/kg}</math>]</i>								
68	1.2	0.01**	0.001	10.00	-	-	-	-
65	1.2	7.29**	1.17	16.05	-	-	-	-
151	7.2	839.884	5.381	0.64	-	-	-	-
204	1.2	4710	430	9.13	-	-	-	-
161	2	8410	1530	18.19	-	-	-	-
126	1.2	17700	1770	10.00	-	-	-	-
<i>Ta (<math>x_{pt} = 311</math>, <math>\sigma_{pt} = 60</math>, <math>u(x_{pt}) = 14</math>) [<math>\mu\text{g/kg}</math>]</i>								
203	5.2	209	9.3	4.45	-1.7	-	-6.1	0.67
215	5.1	239	20	8.37	-1.2	-	-3.0	0.77
172	5.2	285	13	4.56	-0.4	-	-1.4	0.92
192	5.2	285	14	4.91	-0.4	-	-1.3	0.92
152	5.2	302.5	26.81	8.86	-0.1	-	-0.3	0.97
161	2	305	65	21.31	-0.1	-	-0.1	0.98
175	5.2	306.2	30.4	9.93	-0.1	-	-0.1	0.98
221	5.2	307	18	5.86	-0.1	-	-0.2	0.99
217	5.1	307	9	2.93	-0.1	-	-0.2	0.99

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [ $\mu\text{g/g}$ ] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
199	5.1	308.533	25.77	8.35	0.0	-	-0.1	0.99
176	5.2	312	6	1.92	0.0	-	0.1	1.00
171	5.1	317	16	5.05	0.1	-	0.3	1.02
202	5.1	328	68	20.73	0.3	-	0.2	1.05
184	5.2	370	30	8.11	1.0	-	1.8	1.19
194	5.1	380	46.156	12.15	1.2	-	1.4	1.22
178	5.1	425	44.2	10.40	1.9	-	2.5	1.37
77	1.2	43000**	7000	16.28	719.6	-	6.1	138.22
<i>Tb (<math>x_{pt} = 173</math>, <math>\sigma_{pt} = 40</math>, <math>u(x_{pt}) = 10</math>) [\mathbf{\mu g/kg}]</i>								
203	5.2	124	19	15.32	-1.4	-	-2.3	0.72
232	5.1	140	20	14.29	-0.9	-	-1.5	0.81
215	5.1	153	11	7.19	-0.5	-	-1.3	0.89
176	5.2	158	6	3.80	-0.4	-	-1.2	0.92
194	5.1	158	6.47	4.09	-0.4	-	-1.2	0.92
186	5.1	160.85	19.78	12.30	-0.3	-	-0.5	0.93
217	5.1	161.2	4.7	2.92	-0.3	-	-1.0	0.93
221	5.2	168	9	5.36	-0.1	-	-0.3	0.97
171	5.1	169	13	7.69	-0.1	-	-0.2	0.98
191	5.2	170	20	11.76	-0.1	-	-0.1	0.98
192	5.2	180	9	5.00	0.2	-	0.5	1.04
184	5.2	200	10	5.00	0.8	-	1.9	1.16
199	5.1	206.25	22.87	11.09	0.9	-	1.3	1.19
152	5.2	225	22.913	10.18	1.5	-	2.1	1.30
161	2	336*	97	28.87	4.5	-	1.7	1.95
<i>Tm [\mathbf{\mu g/kg}]</i>								
192	5.2	117	8	6.84	-	-	-	-
<i>W [\mathbf{\mu g/kg}]</i>								
68	1.2	0.05**	0.001	2.00	-	-	-	-
192	5.2	533	53	9.94	-	-	-	-
172	5.2	659	57	8.65	-	-	-	-
221	5.2	735	107	14.56	-	-	-	-
176	5.2	790	30	3.80	-	-	-	-
77	1.2	71000**	8000	11.27	-	-	-	-
<i>Yb (<math>x_{pt} = 810</math>, <math>\sigma_{pt} = 130</math>, <math>u(x_{pt}) = 50</math>) [\mathbf{\mu g/kg}]</i>								
194	5.1	637	44.46	6.98	-	-1.2	-2.7	0.78
202	5.1	643	37	5.75	-	-1.2	-2.8	0.79
215	5.1	660	60	9.09	-	-1.1	-2.0	0.81
172	5.2	674	27	4.01	-	-1.0	-2.6	0.83
186	5.1	700.8	98.46	14.05	-	-0.8	-1.0	0.86
217	5.1	718	11	1.53	-	-0.7	-2.0	0.88
232	5.1	770	50	6.49	-	-0.3	-0.6	0.95
176	5.2	775	21	2.71	-	-0.3	-0.7	0.95
184	5.2	800	60	7.50	-	-0.1	-0.2	0.98
178	5.1	820	180	21.95	-	0.1	0.0	1.01
192	5.2	825	41	4.97	-	0.1	0.2	1.02

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE Zeta-SCORES AND THE R-SCORES FOR RESULTS IN THE [ $\mu\text{g/g}$ ] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	Zeta-score	R-score
191	5.2	870	90	10.34	-	0.4	0.6	1.07
171	5.1	880	70	7.95	-	0.5	0.8	1.08
221	5.2	968	111	11.47	-	1.1	1.3	1.19
152	5.2	985	101.612	10.32	-	1.2	1.5	1.21
175	5.2	1041	113	10.85	-	1.6	1.9	1.28
161	2	3060*	660	21.57	-	15.8	3.4	3.77
Zn [ $\mu\text{g/kg}$ ]								
68	1.2	0.002**	0.001	50.00	-	-	-	-
94	1.2	15.5**	0.7	4.52	-	-	-	-
65	1.2	19.85**	2.04	10.28	-	-	-	-
154	7.1	4901	101	2.06	-	-	-	-
209	1.3	5526	78	1.41	-	-	-	-
203	5.2	7040	790	11.22	-	-	-	-
233	1.2	8300	1400	16.87	-	-	-	-
116	1.3	8786.7	786	8.95	-	-	-	-
105	1.3	9000	750	8.33	-	-	-	-
176	5.2	9310	200	2.15	-	-	-	-
192	5.2	9630	480	4.98	-	-	-	-
171	5.1	9790	670	6.84	-	-	-	-
172	5.2	10142	471	4.64	-	-	-	-
215	5.1	10360	860	8.30	-	-	-	-
196	5.2	10870	2000	18.40	-	-	-	-
124	1.2	10900	636.39	5.84	-	-	-	-
36	6.1	12000	1000	8.33	-	-	-	-
175	5.2	12103	1010	8.35	-	-	-	-
230	1.2	12200	2400	19.67	-	-	-	-
232	5.1	12200	900	7.38	-	-	-	-
152	5.2	12640	642.495	5.08	-	-	-	-
217	5.1	13110	524	4.00	-	-	-	-
55	5.2	13203	7921.8	60.00	-	-	-	-
184	5.2	13800	900	6.52	-	-	-	-
178	5.1	14100	1440	10.21	-	-	-	-
199	5.1	14320	800	5.59	-	-	-	-
186	5.1	14915	2431.145	16.30	-	-	-	-
149	5.2	15272.96	2463.43	16.13	-	-	-	-
126	1.2	15400	1500	9.74	-	-	-	-
53	1.3	15663	1566	10.00	-	-	-	-
194	5.1	15700	2198	14.00	-	-	-	-
108	1.3	16422	3523	21.45	-	-	-	-
227	2	18020	3363	18.66	-	-	-	-
102	1.2	20000	2500	12.50	-	-	-	-
75	1.3	20962.79	649.59	3.10	-	-	-	-
44	4.2	21979.695	933.237	4.25	-	-	-	-
137	1.2	22133	2511	11.35	-	-	-	-
161	2	22900	3500	15.28	-	-	-	-
78	1.2	23378	1641	7.02	-	-	-	-
204	1.2	25050	3950	15.77	-	-	-	-
77	1.2	29000	3000	10.34	-	-	-	-

TABLE 4 (cont.). SUMMARY OF THE REPORTED RESULTS, THE CALCULATED  $z$ - or  $z'$ -SCORES, THE *Zeta*-SCORES AND THE *R*-SCORES FOR RESULTS IN THE [ $\mu\text{g/g}$ ] RANGE.

Participant code	Technique code	Measurand mass fraction	Standard deviation	Relative std. dev., [%]	$z$ -score	$z'$ -score	<i>Zeta</i> -score	<i>R</i> -score
151	7.2	30434.218	27.948	0.09	-	-	-	-
89	1.2	30813	1160	3.76	-	-	-	-
202	5.1	34074	429	1.26	-	-	-	-
221	5.2	40400	3000	7.43	-	-	-	-
54	1.2	57311	8540	14.90	-	-	-	-
129	1.2	143100**	22860	15.97	-	-	-	-
205	5.2	150000**	4.633	0.00	-	-	-	-
39	1.2	670000**	32000	4.78	-	-	-	-

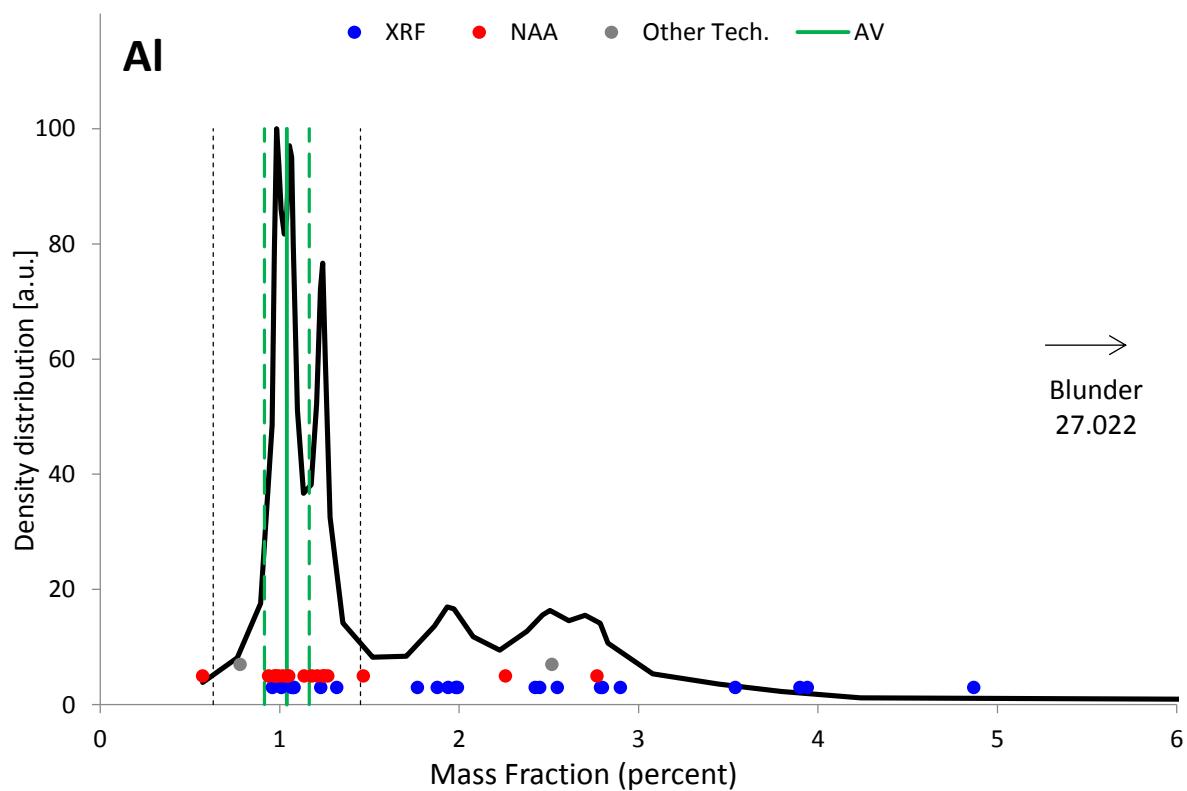


FIG. 6. Density distribution function for the measurand Al.

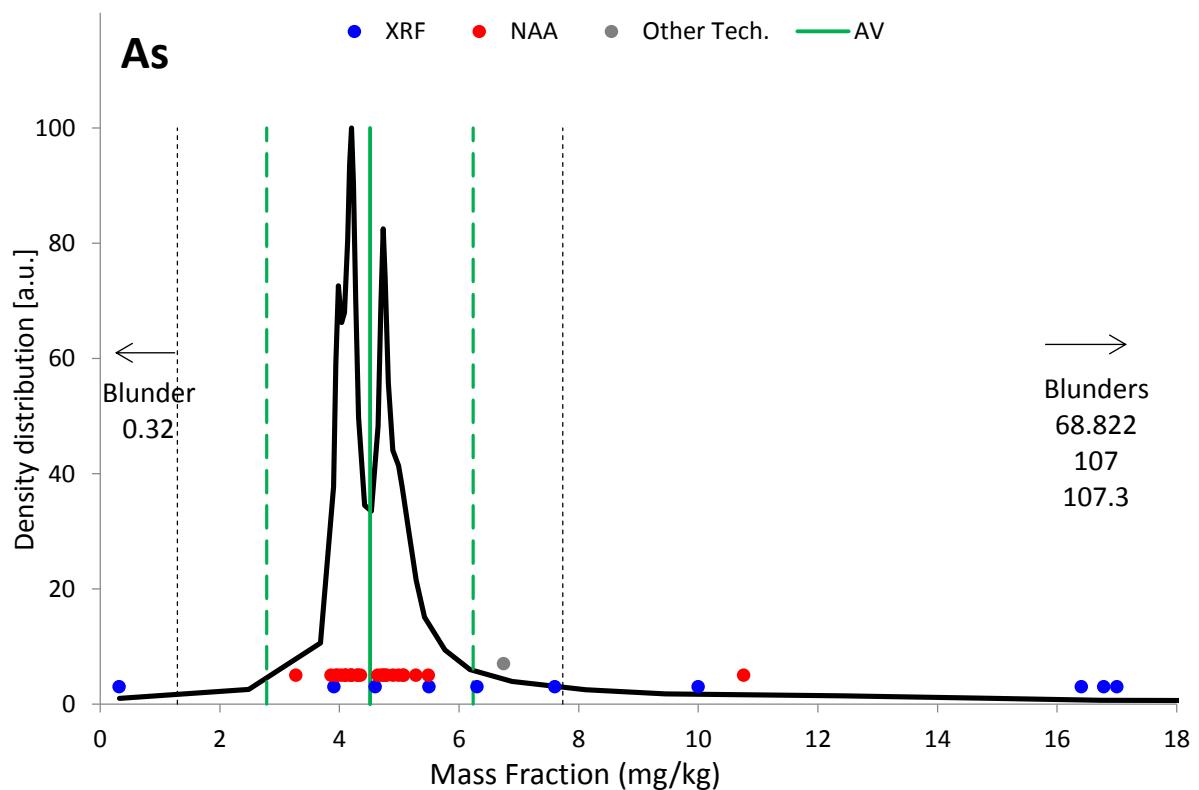


FIG. 7. Density distribution function for the measurand As.

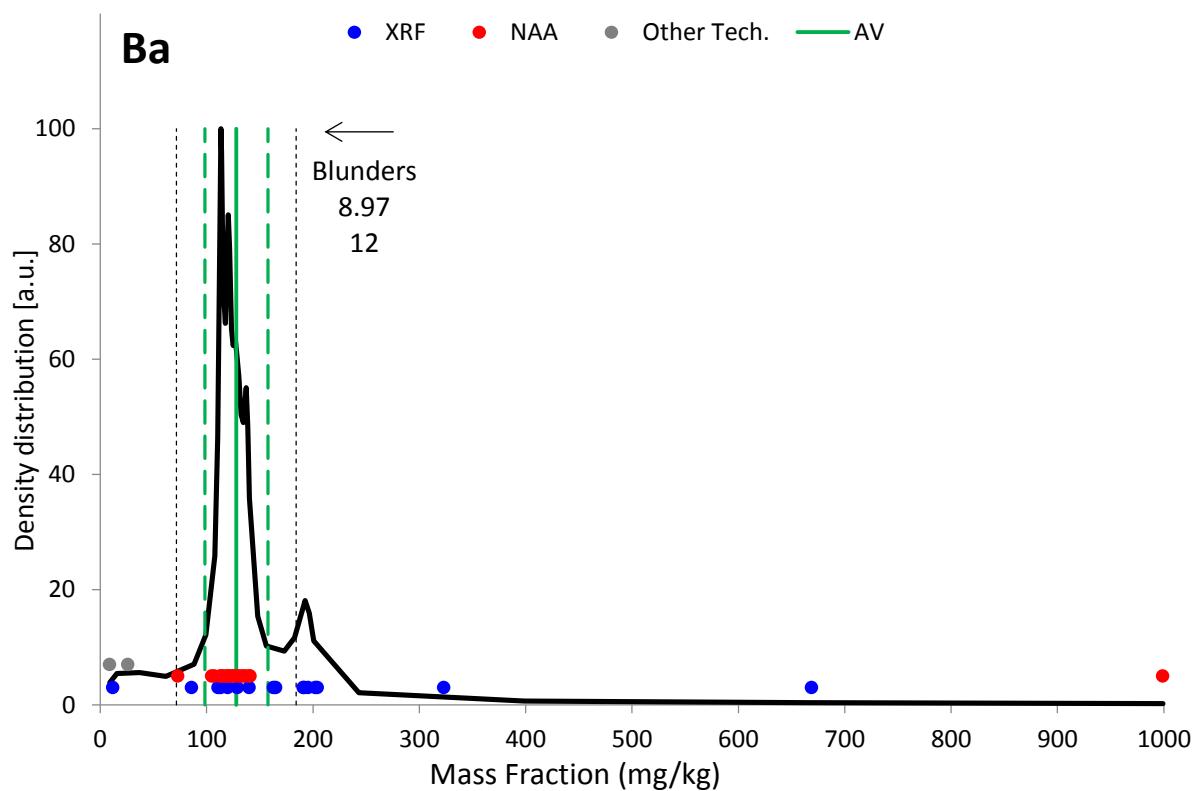


FIG. 8. Density distribution function for the measurand Ba.

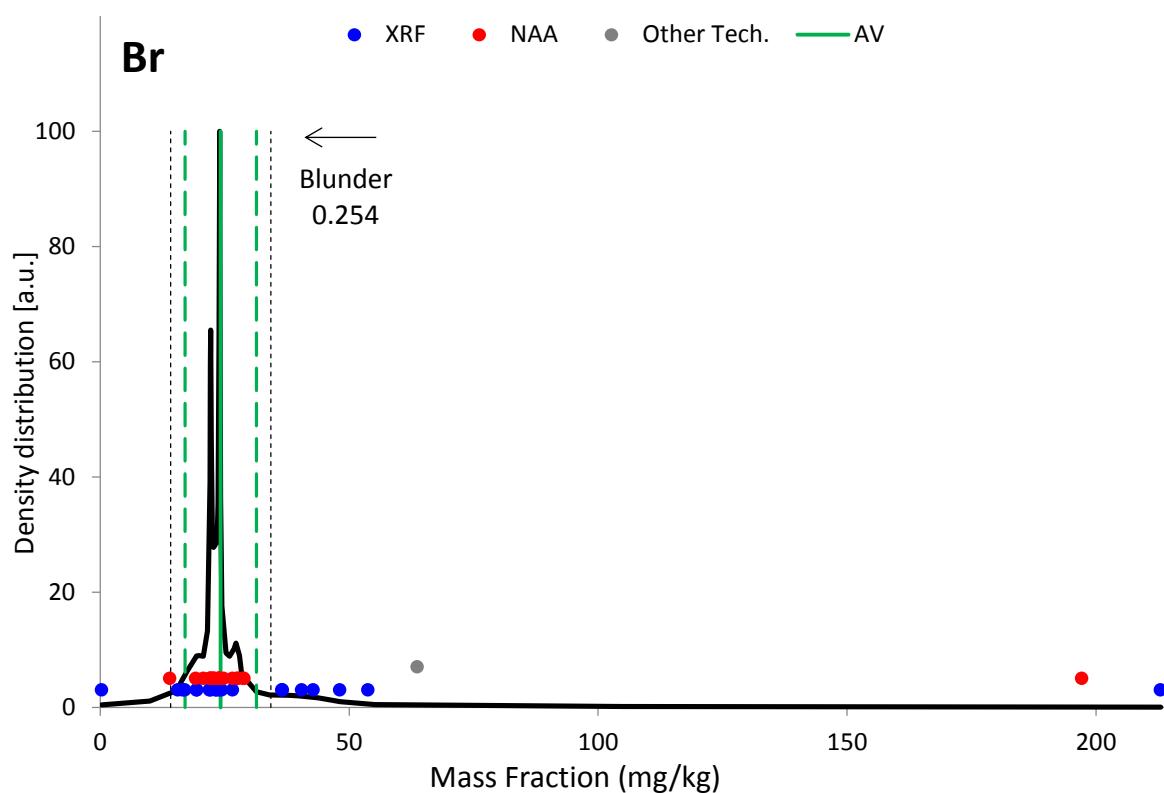


FIG. 9. Density distribution function for the measurand Br.

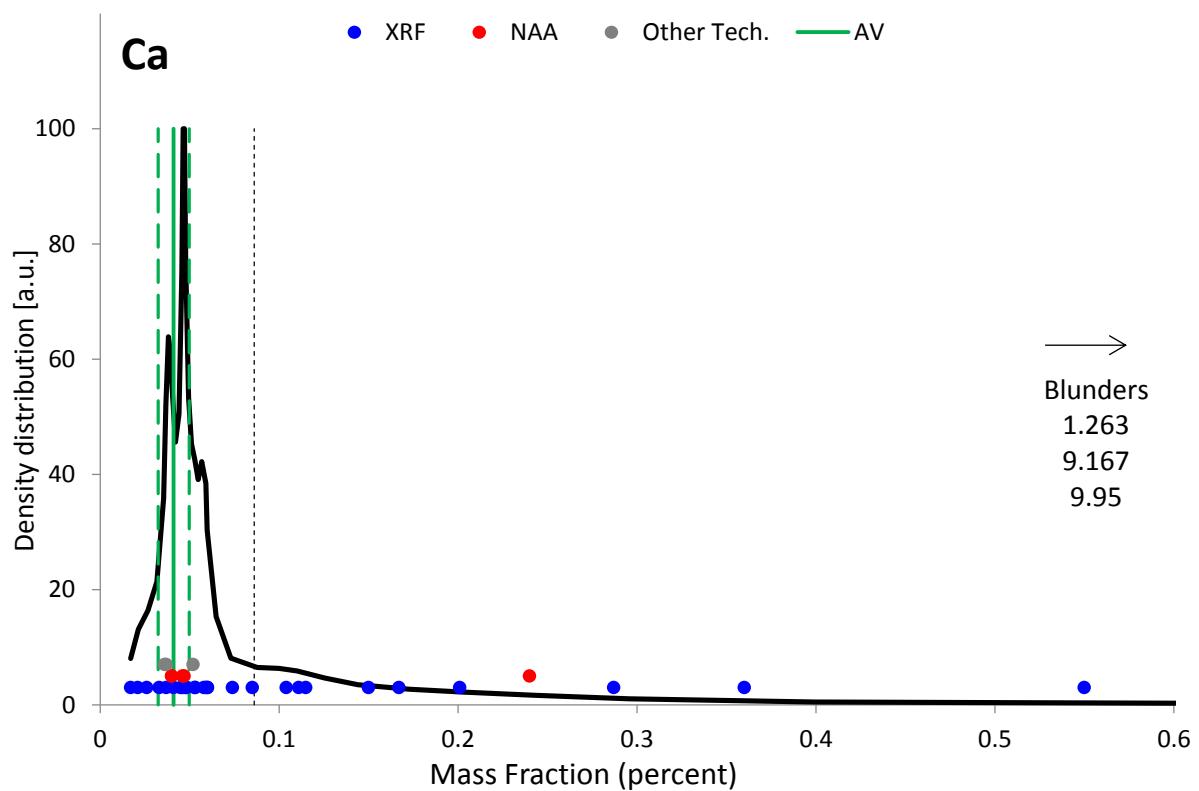


FIG. 10. Density distribution function for the measurand Ca.

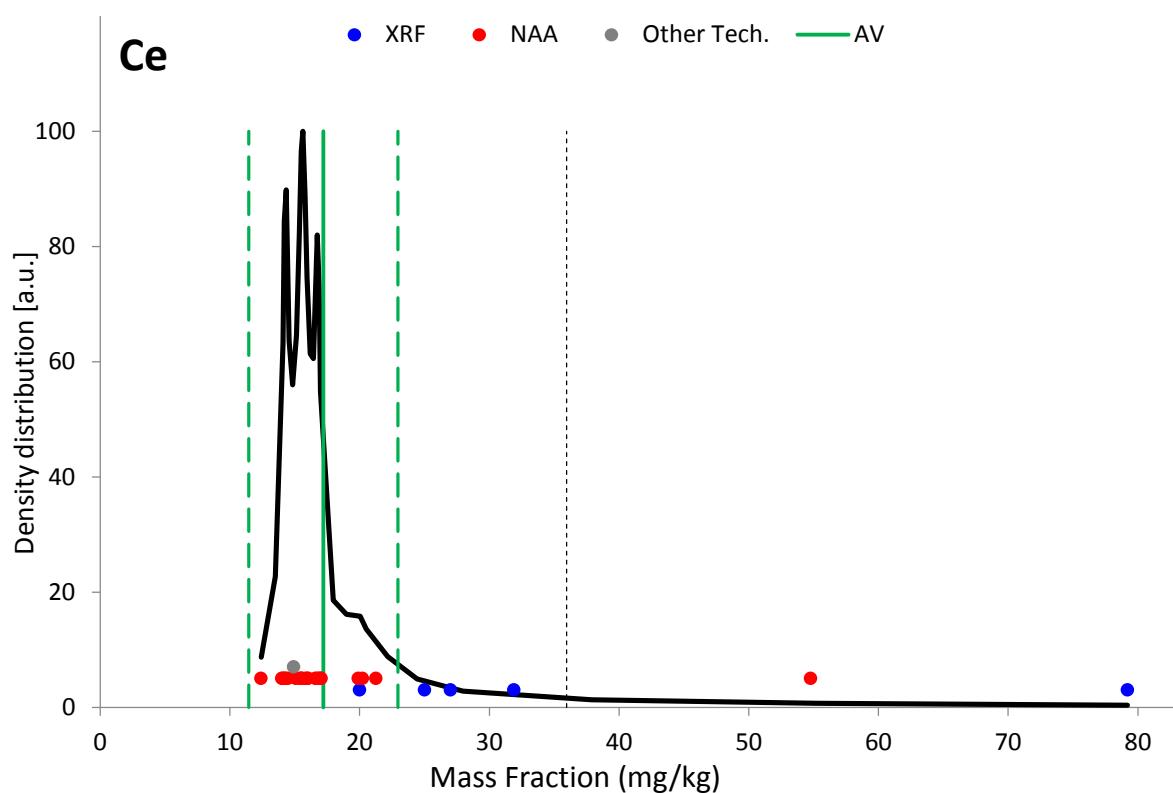


FIG. 11. Density distribution function for the measurand Ce.

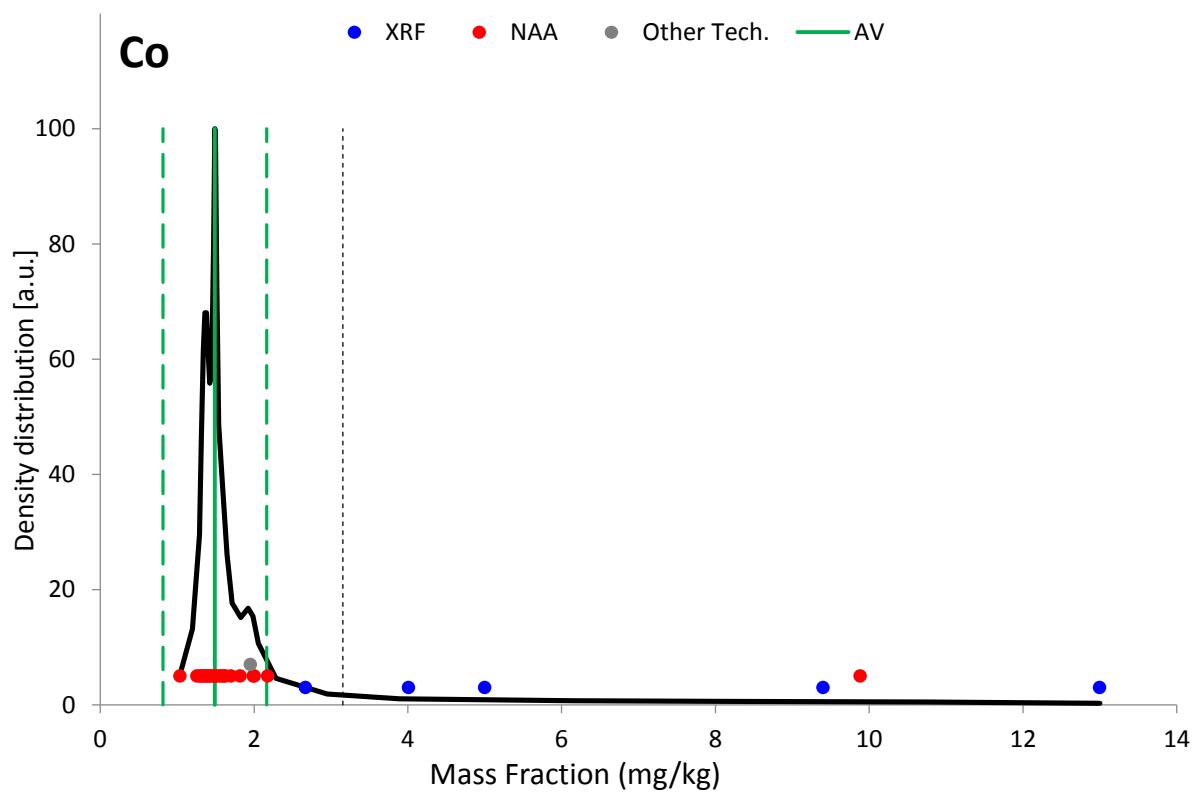


FIG. 12. Density distribution function for the measurand Co.

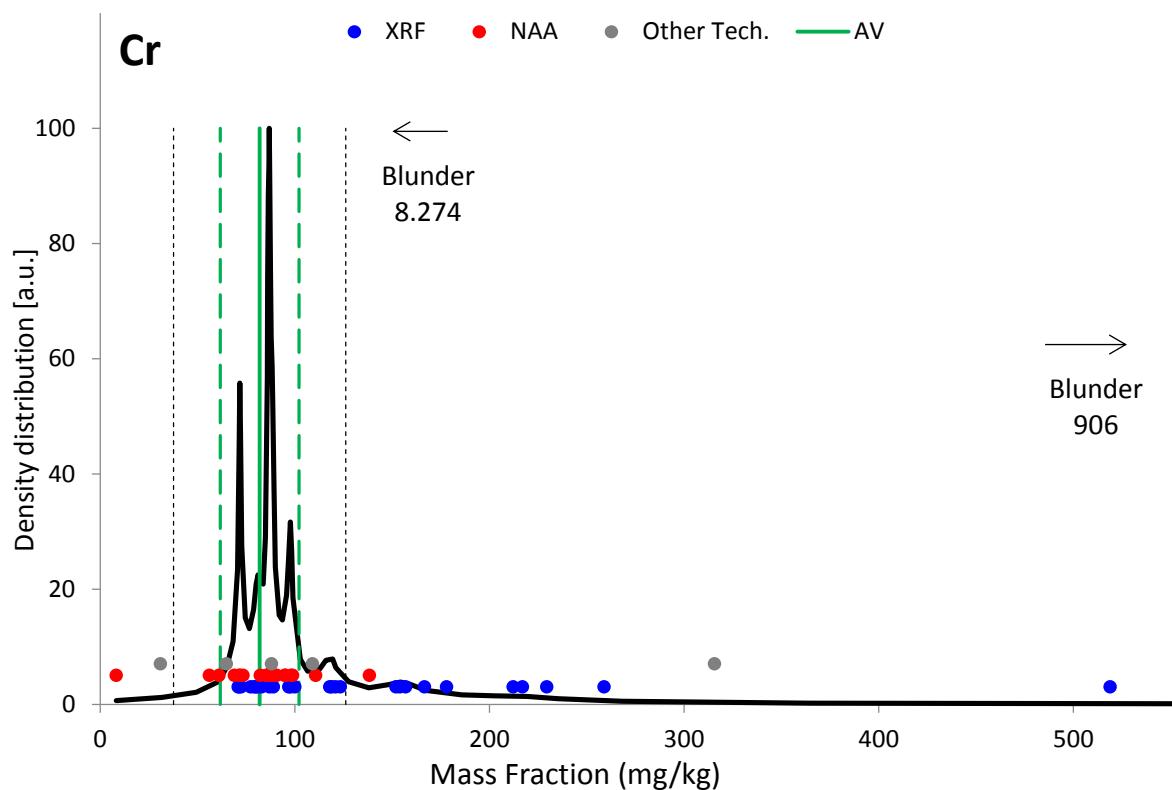


FIG. 13. Density distribution function for the measurand Cr.

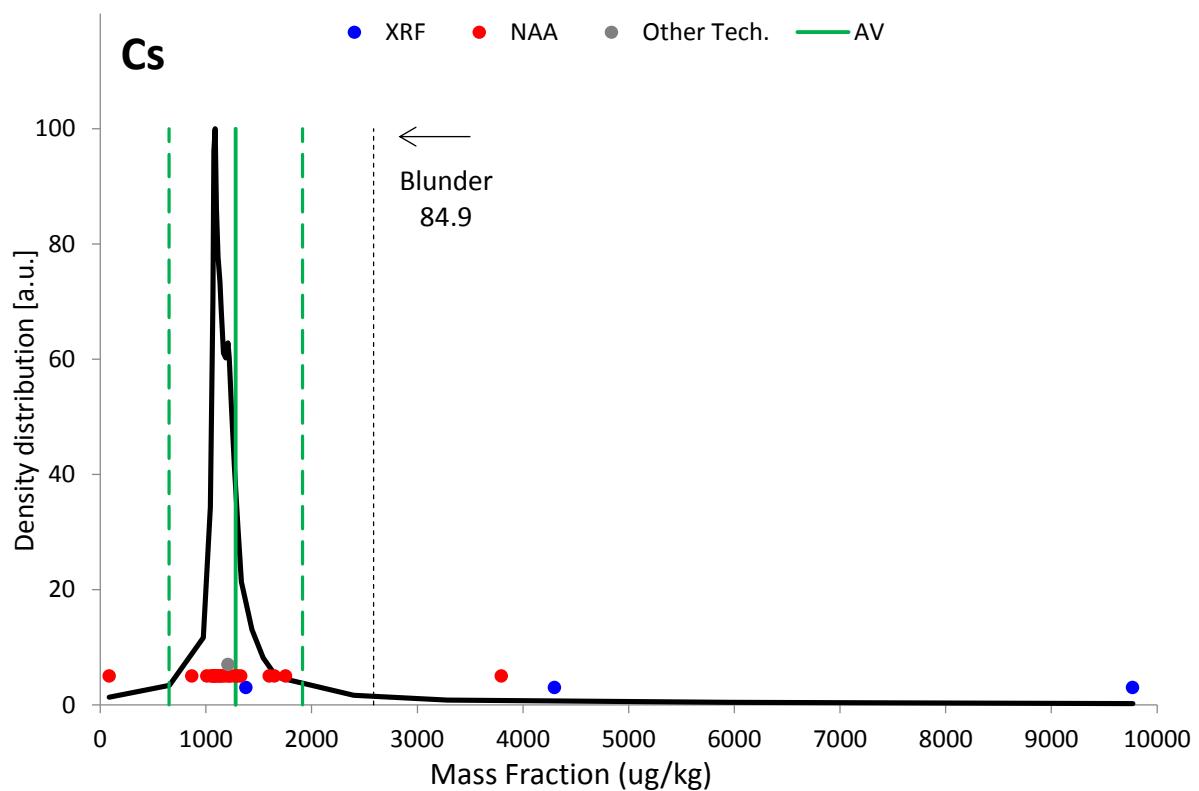


FIG. 14. Density distribution function for the measurand Cs.

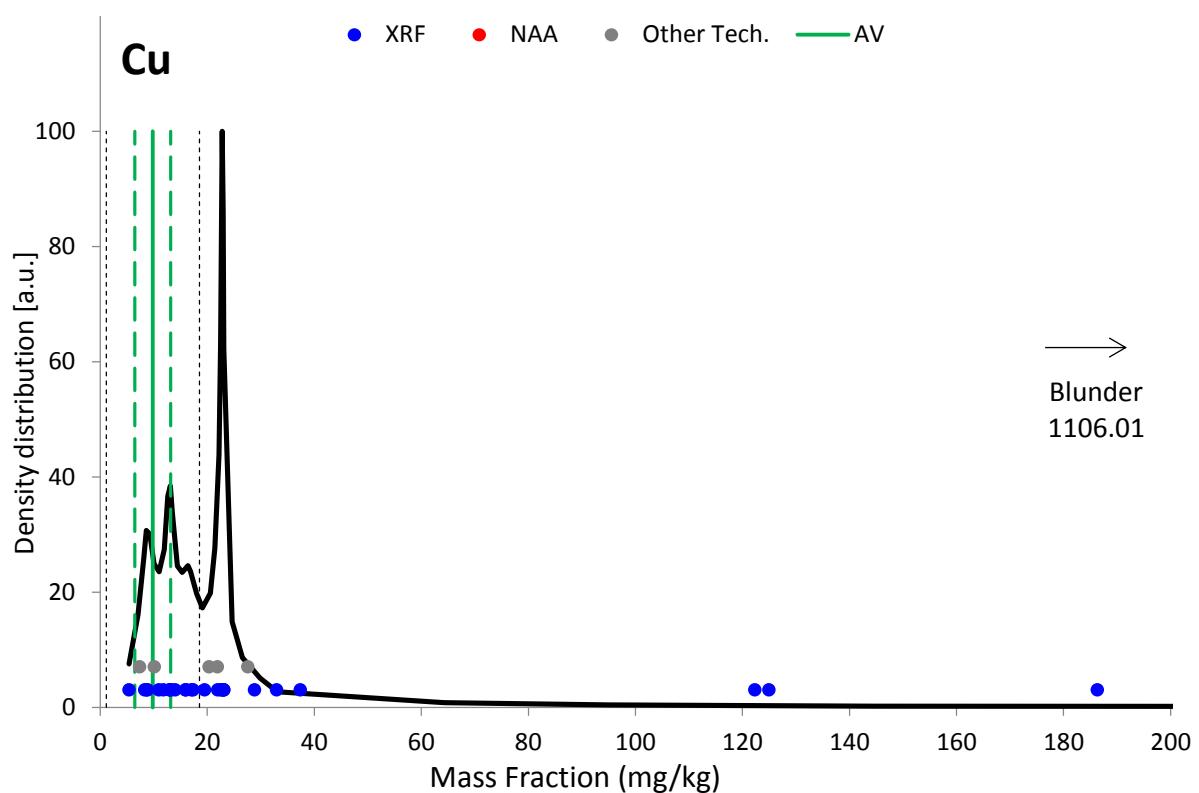


FIG. 15. Density distribution function for the measurand Cu.

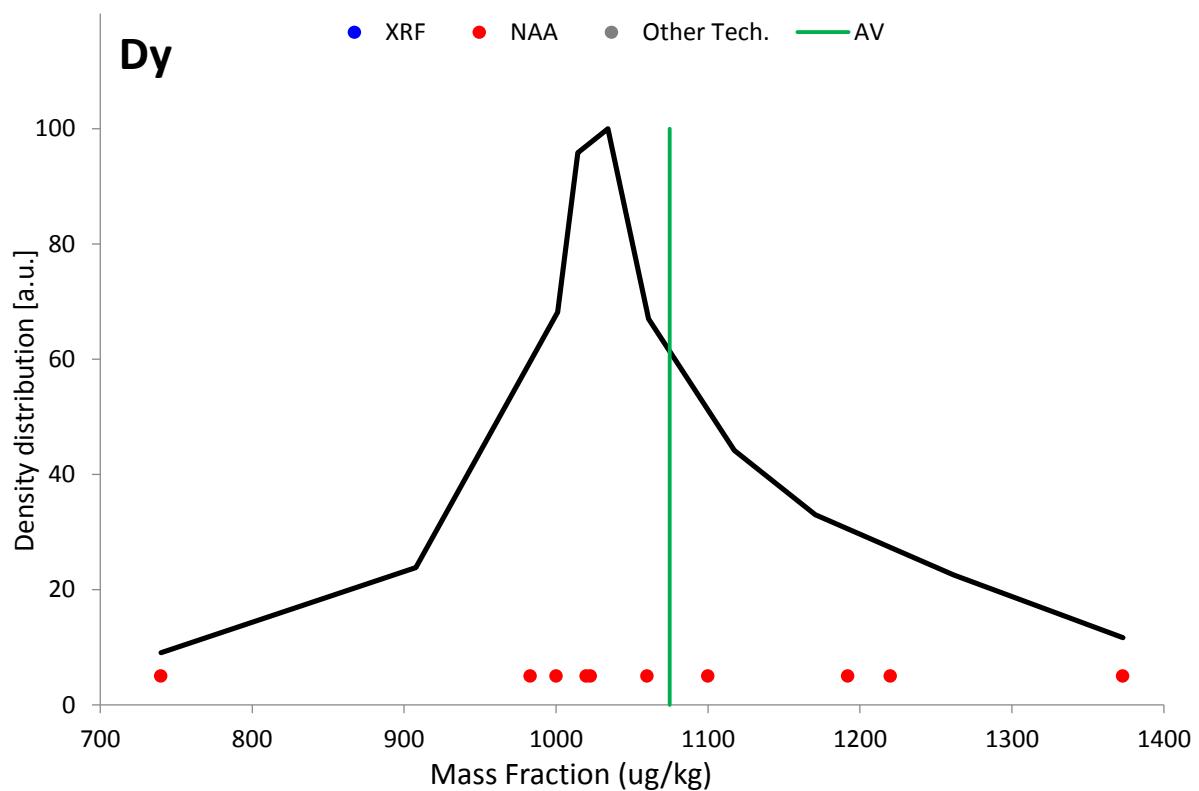


FIG. 16. Density distribution function for the measurand Dy.

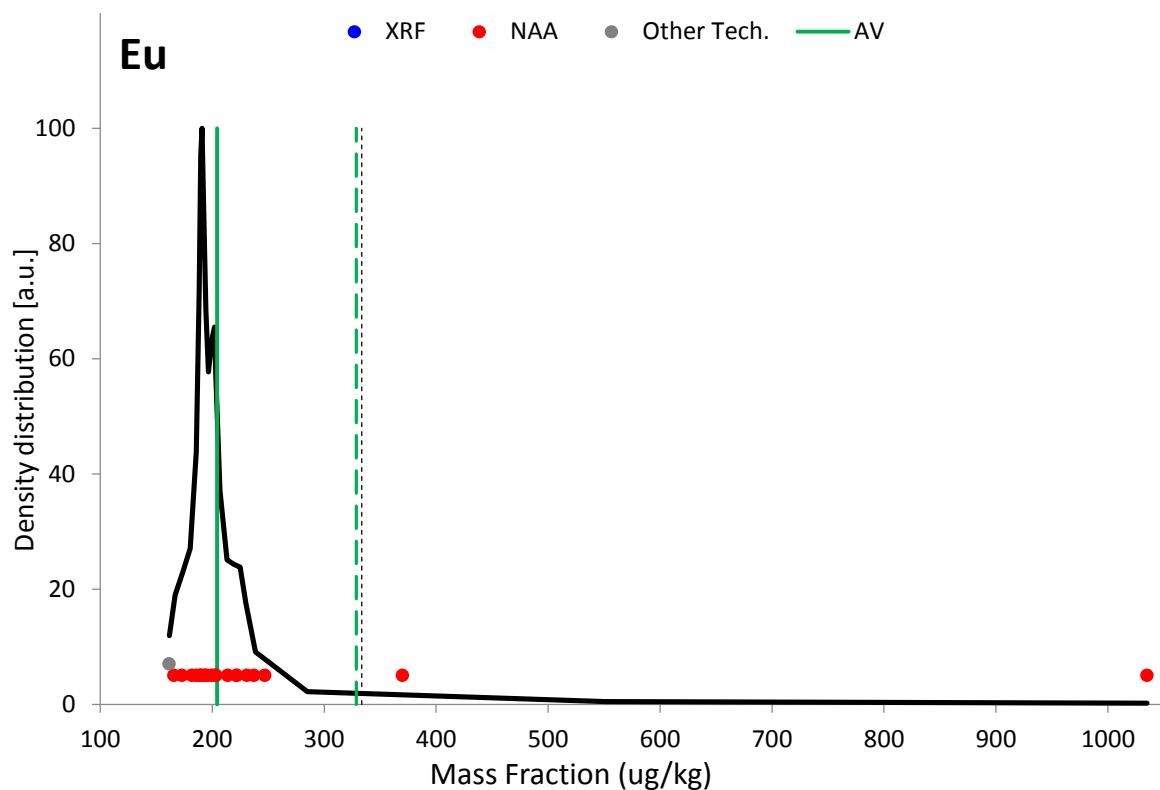


FIG. 17. Density distribution function for the measurand Eu.

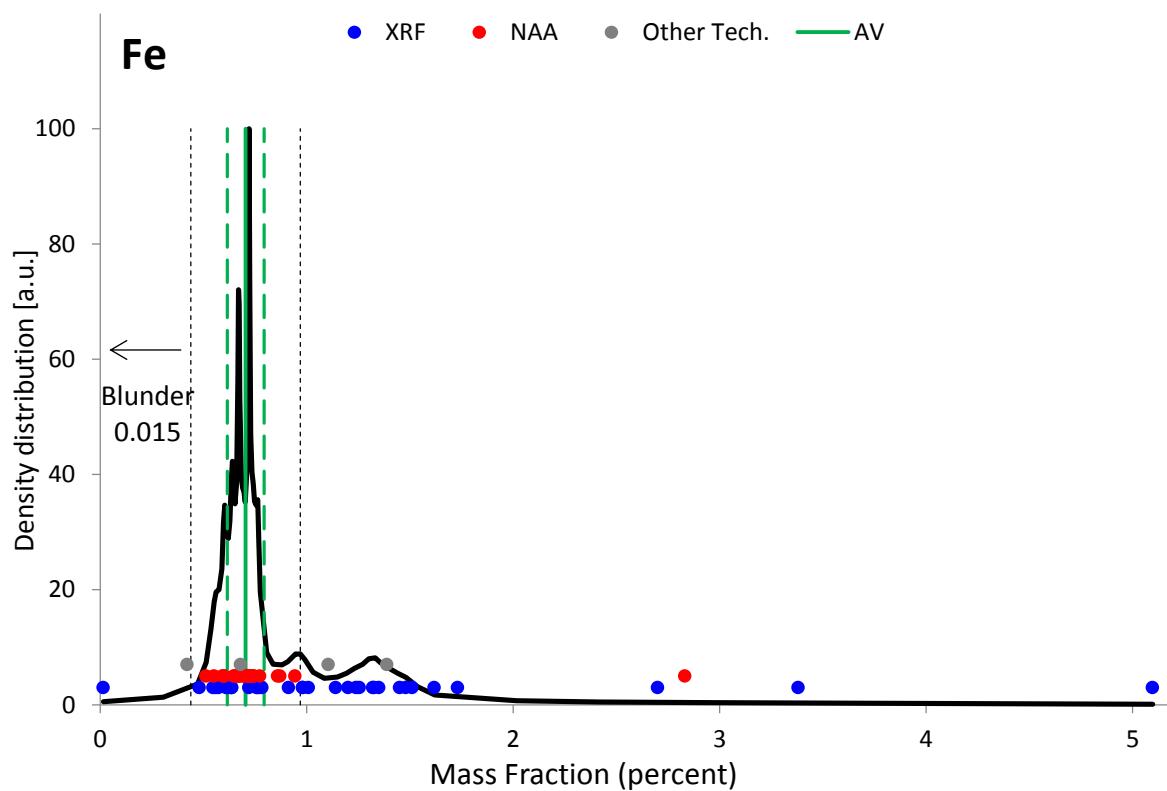


FIG. 18. Density distribution function for the measurand Fe.

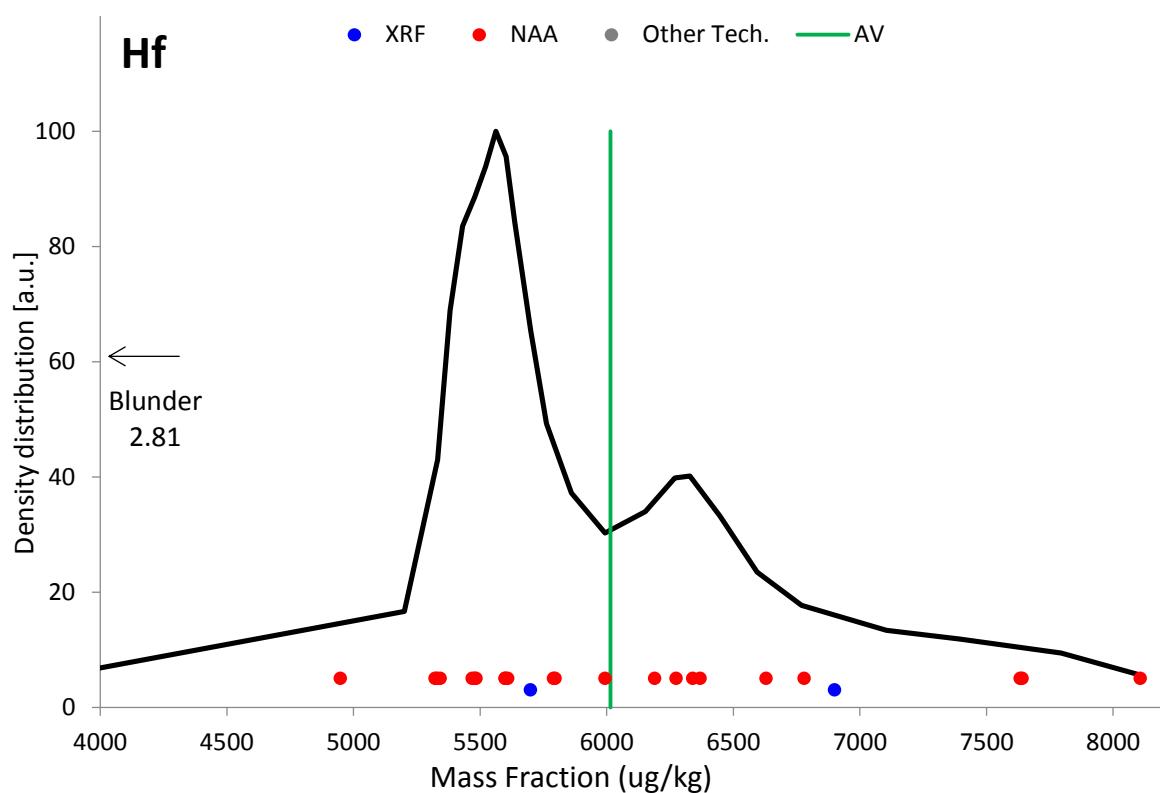


FIG. 19. Density distribution function for the measurand Hf.

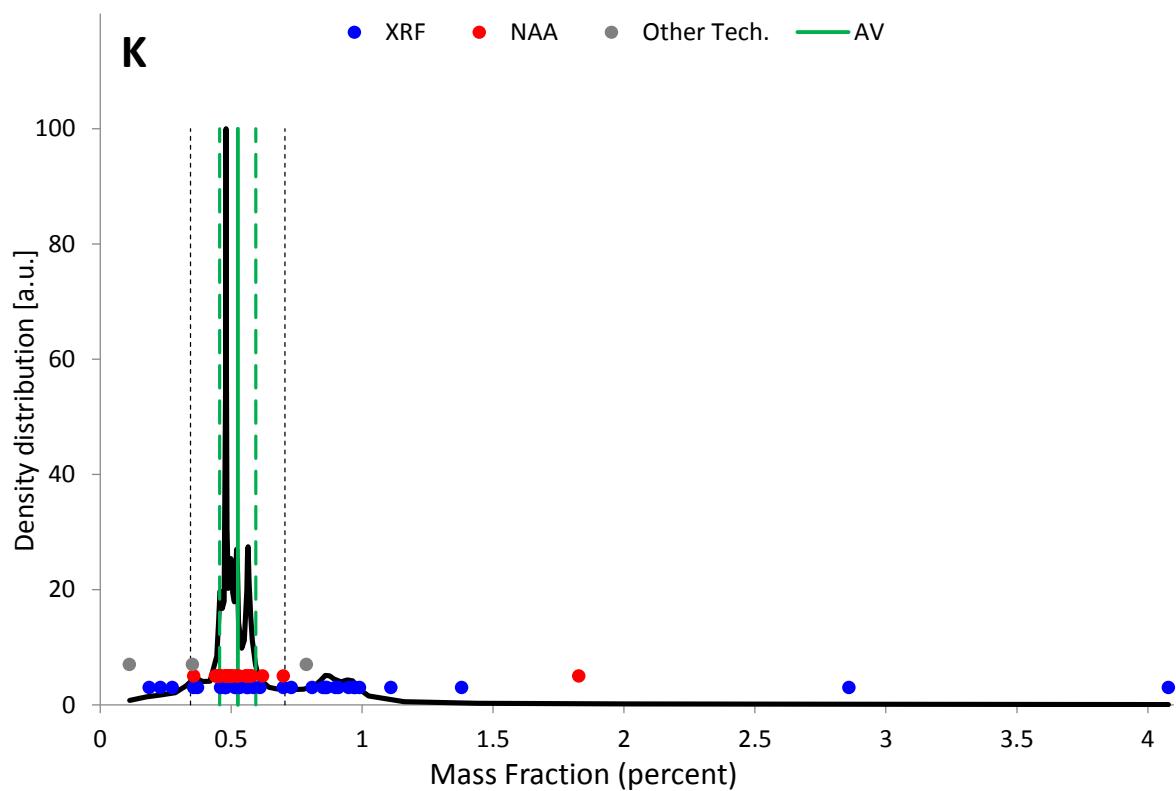


FIG. 20. Density distribution function for the measurand K.

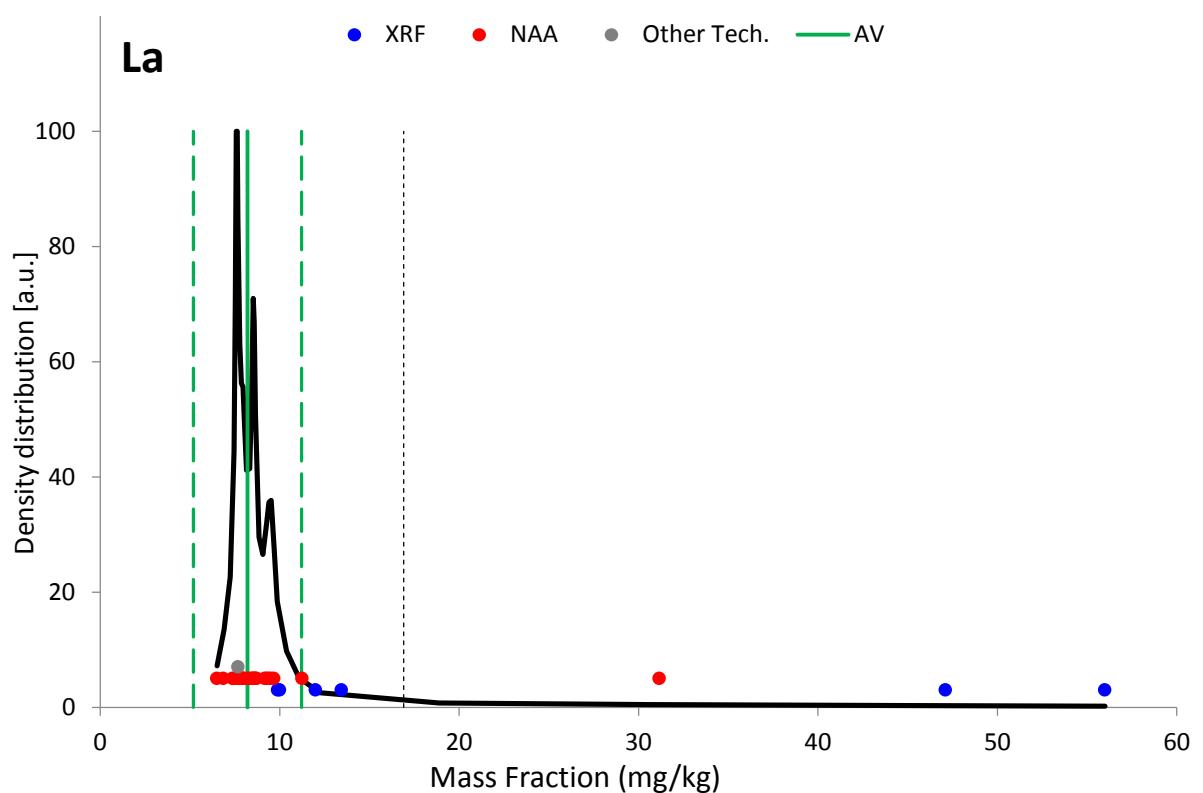


FIG. 21. Density distribution function for the measurand La.

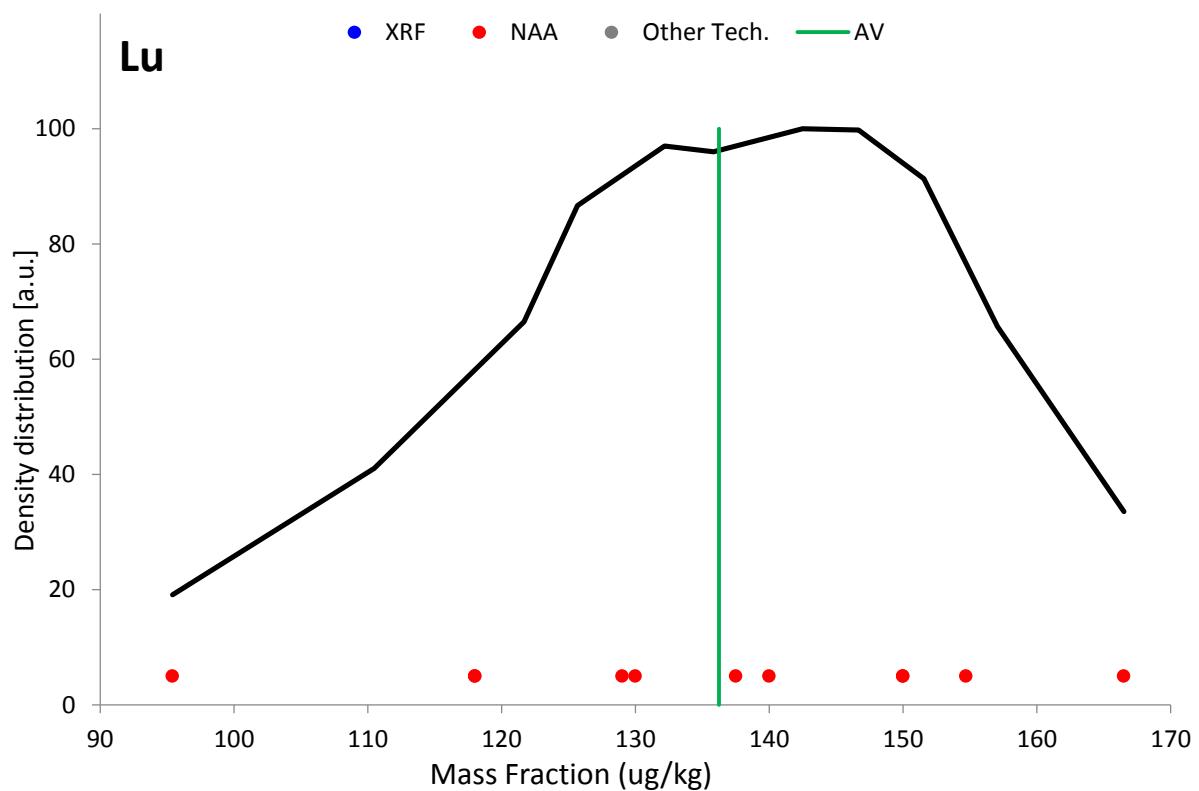


FIG. 22. Density distribution function for the measurand Lu.

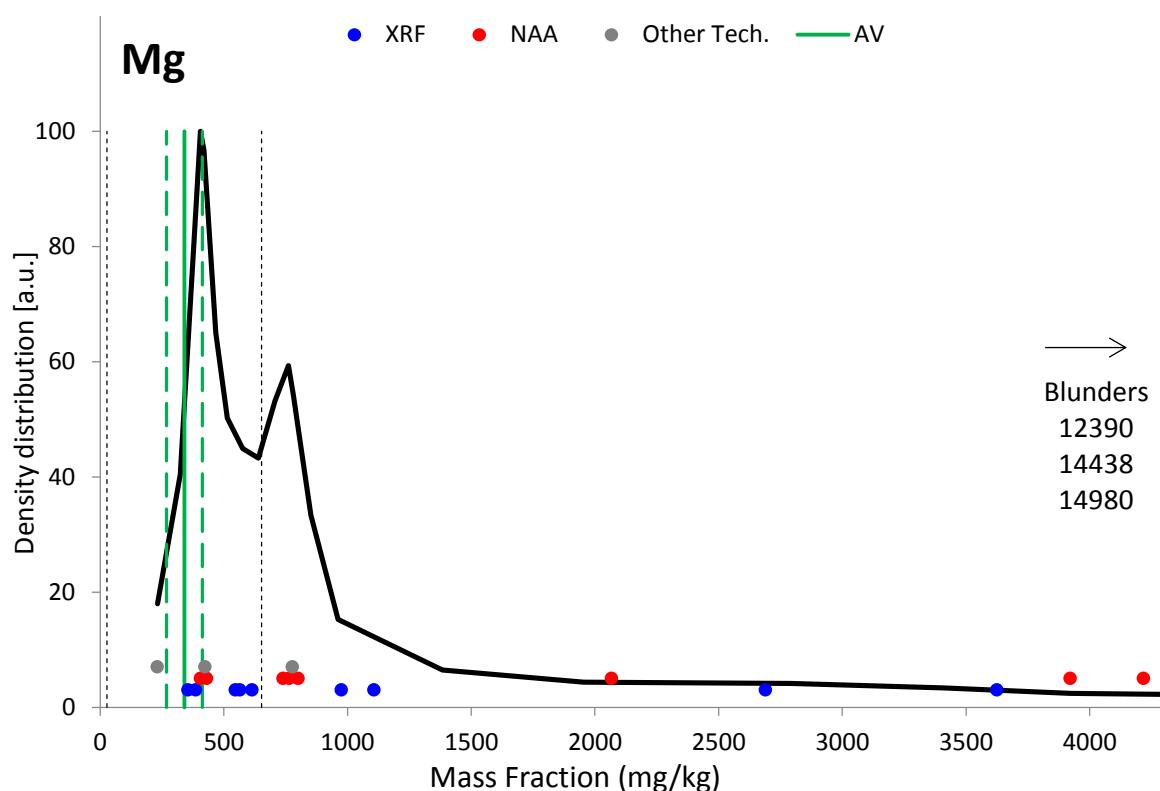


FIG. 23. Density distribution function for the measurand Mg.

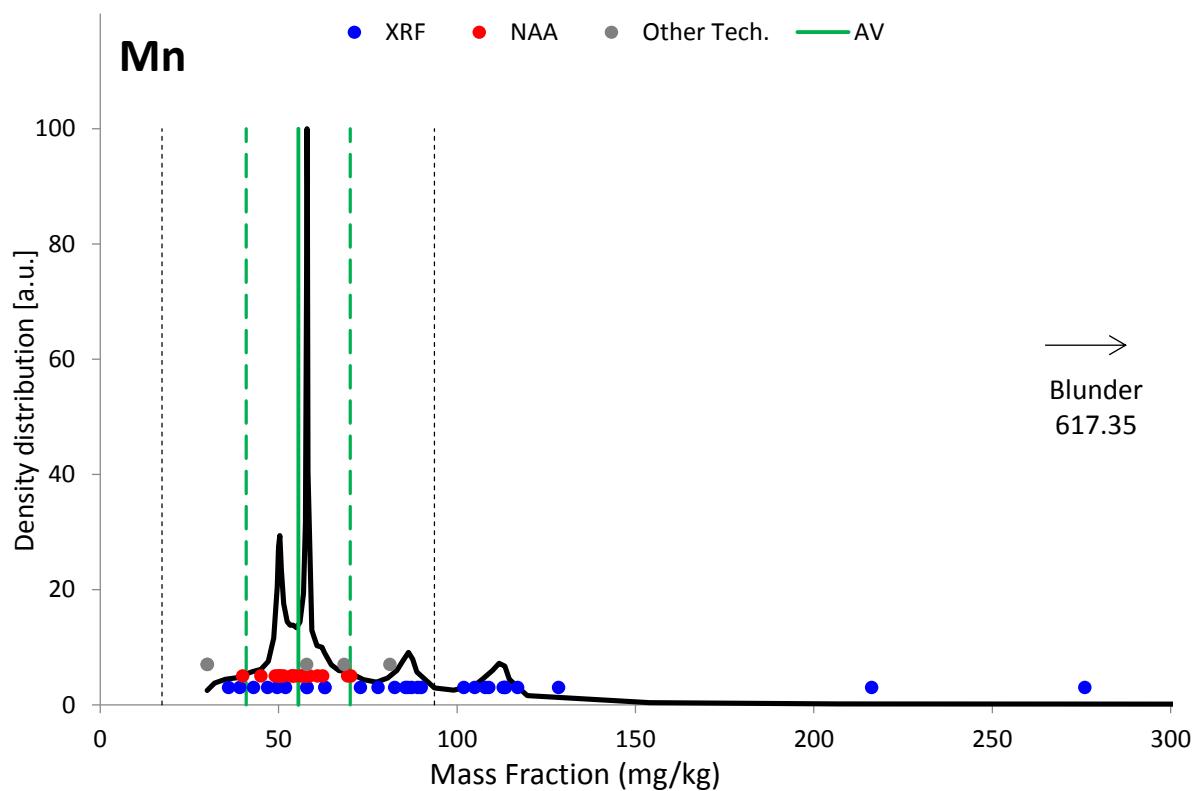


FIG. 24. Density distribution function for the measurand Mn.

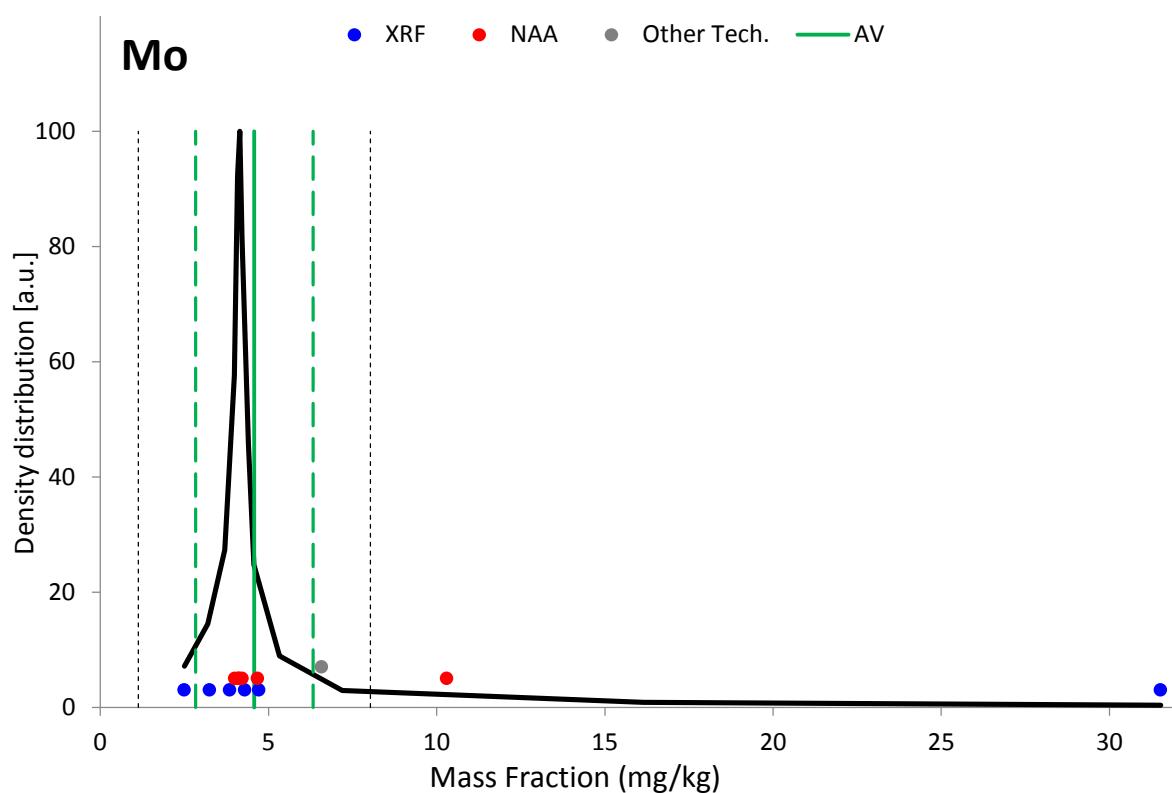


FIG. 25. Density distribution function for the measurand Mo.

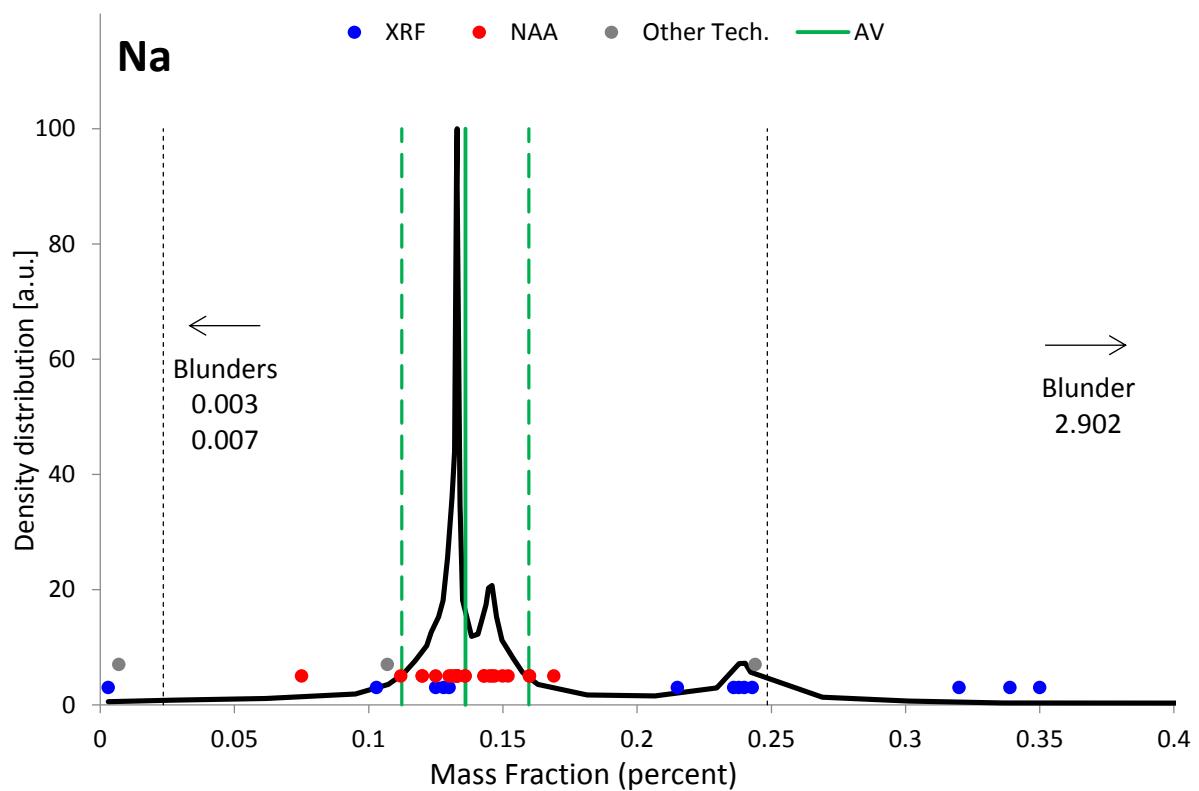


FIG. 26. Density distribution function for the measurand Na.

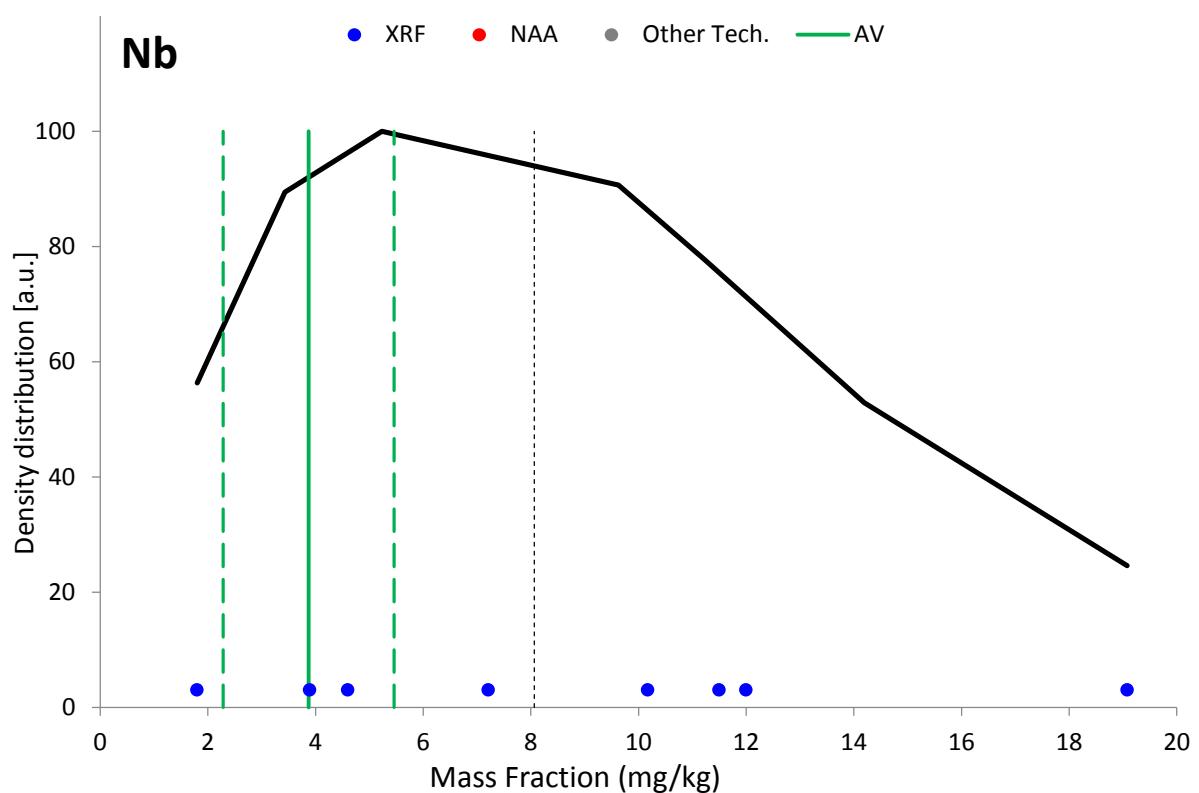


FIG. 27. Density distribution function for the measurand Nb.

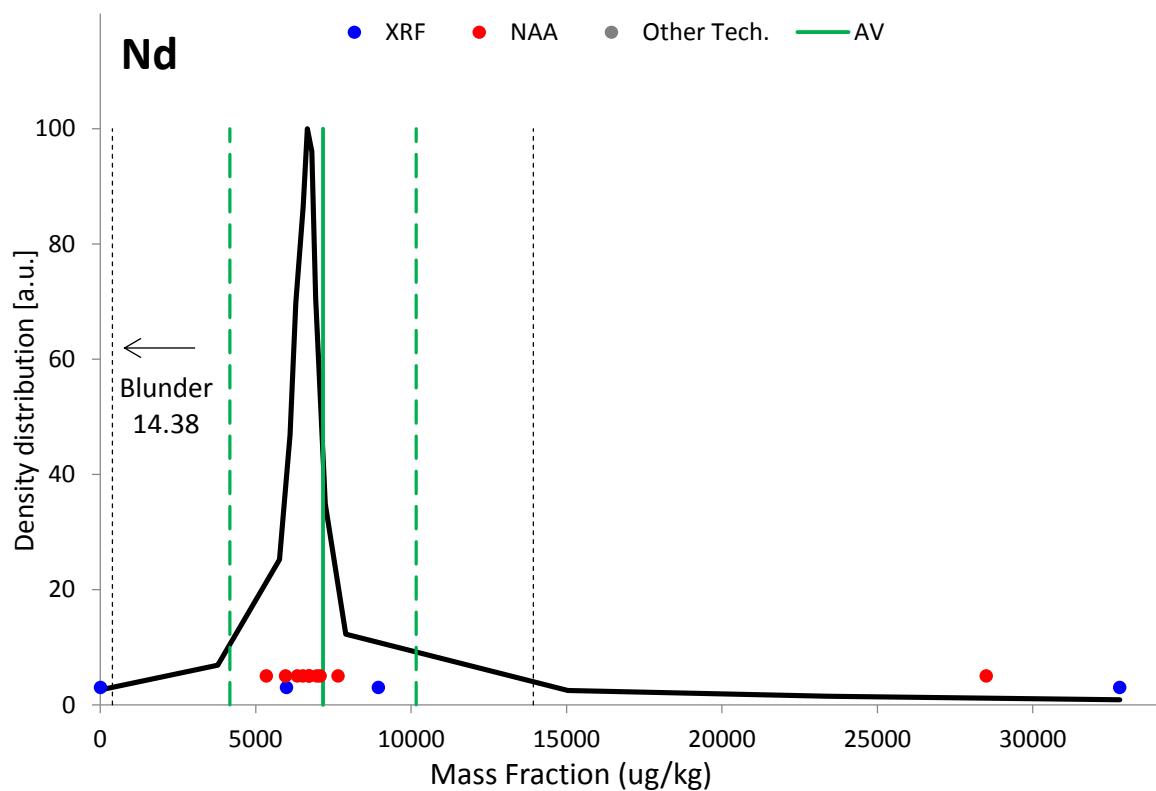


FIG. 28. Density distribution function for the measurand Nd.

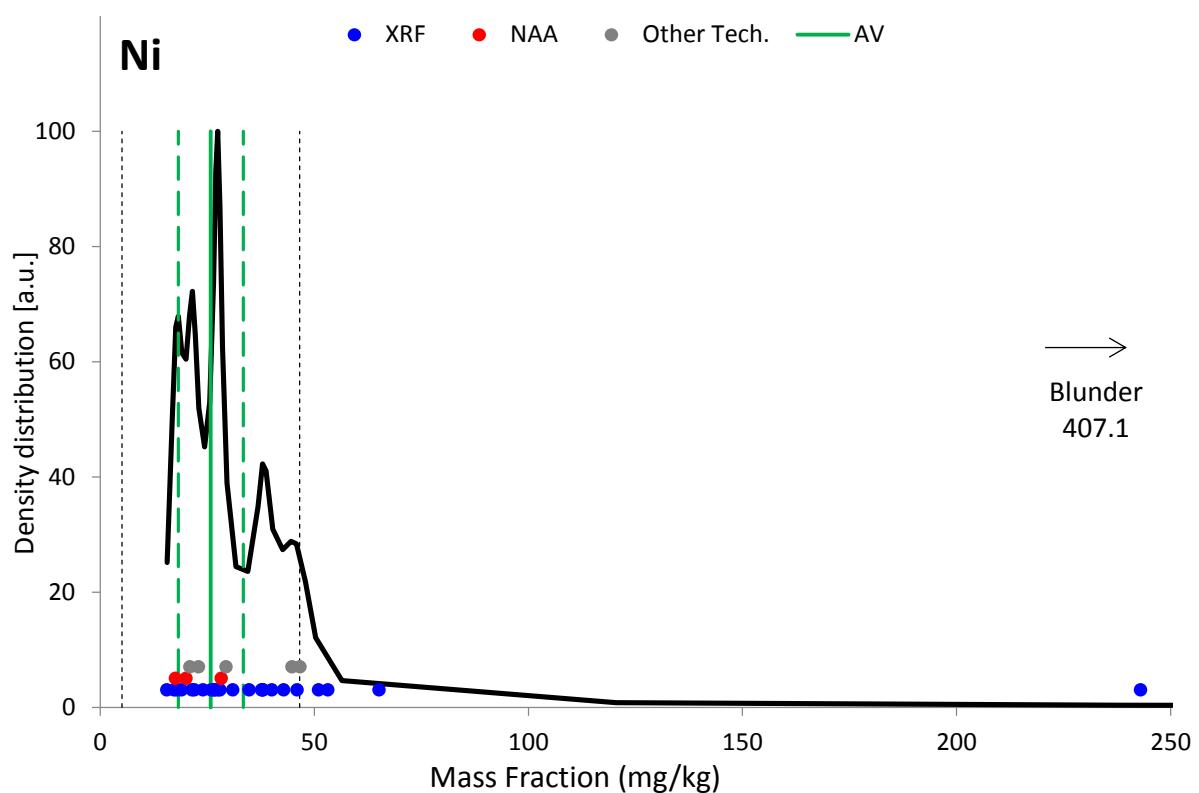


FIG. 29. Density distribution function for the measurand Ni.

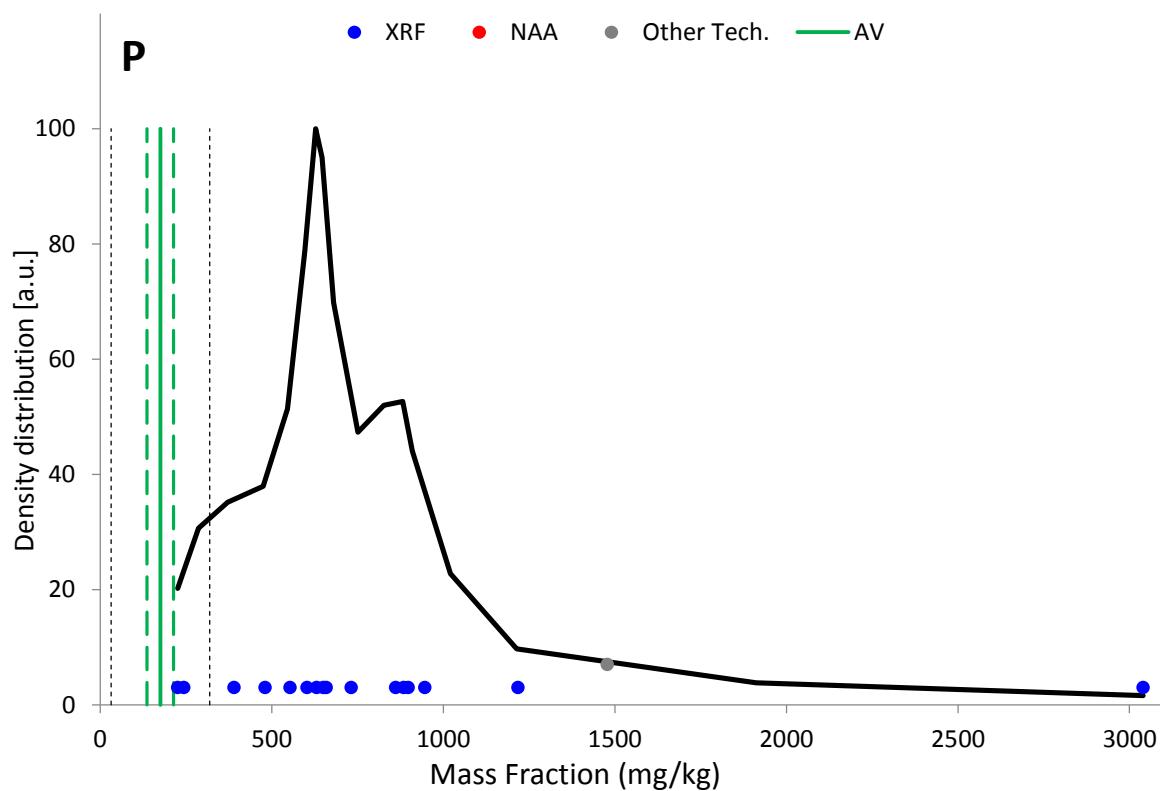


FIG. 30. Density distribution function for the measurand P.

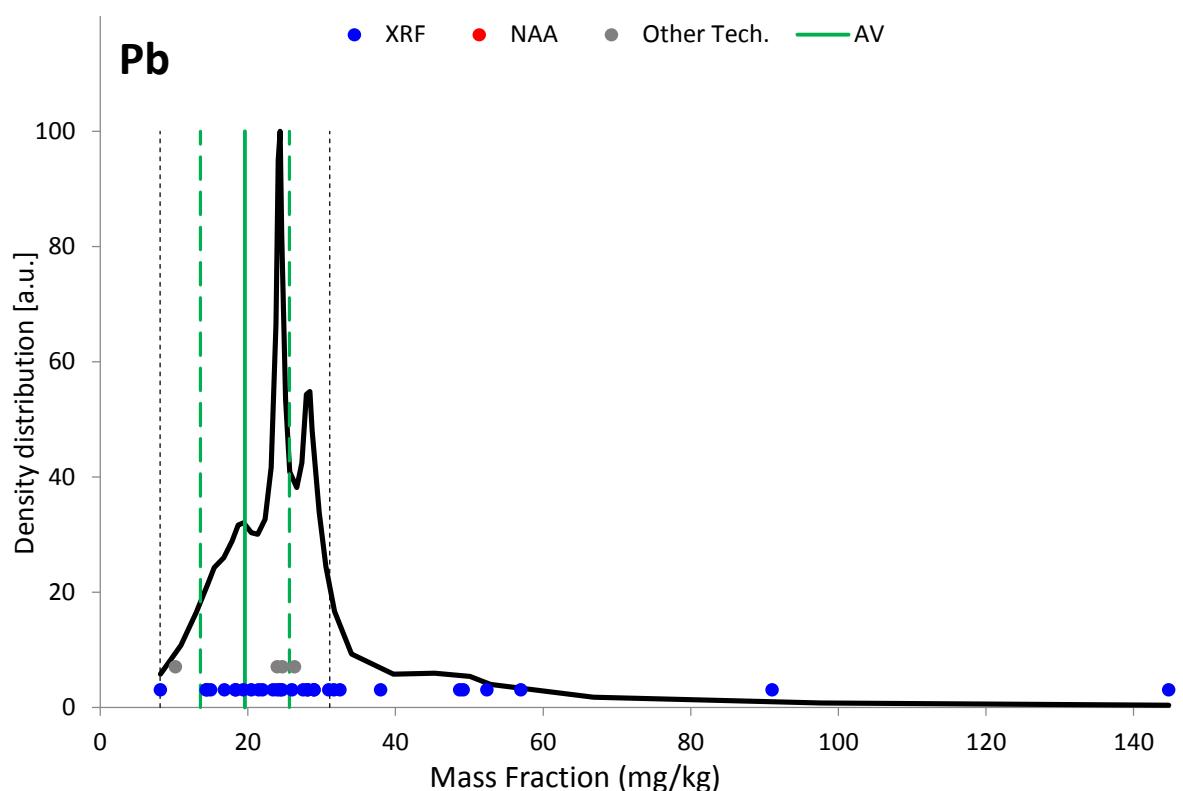


FIG. 31. Density distribution function for the measurand Pb.

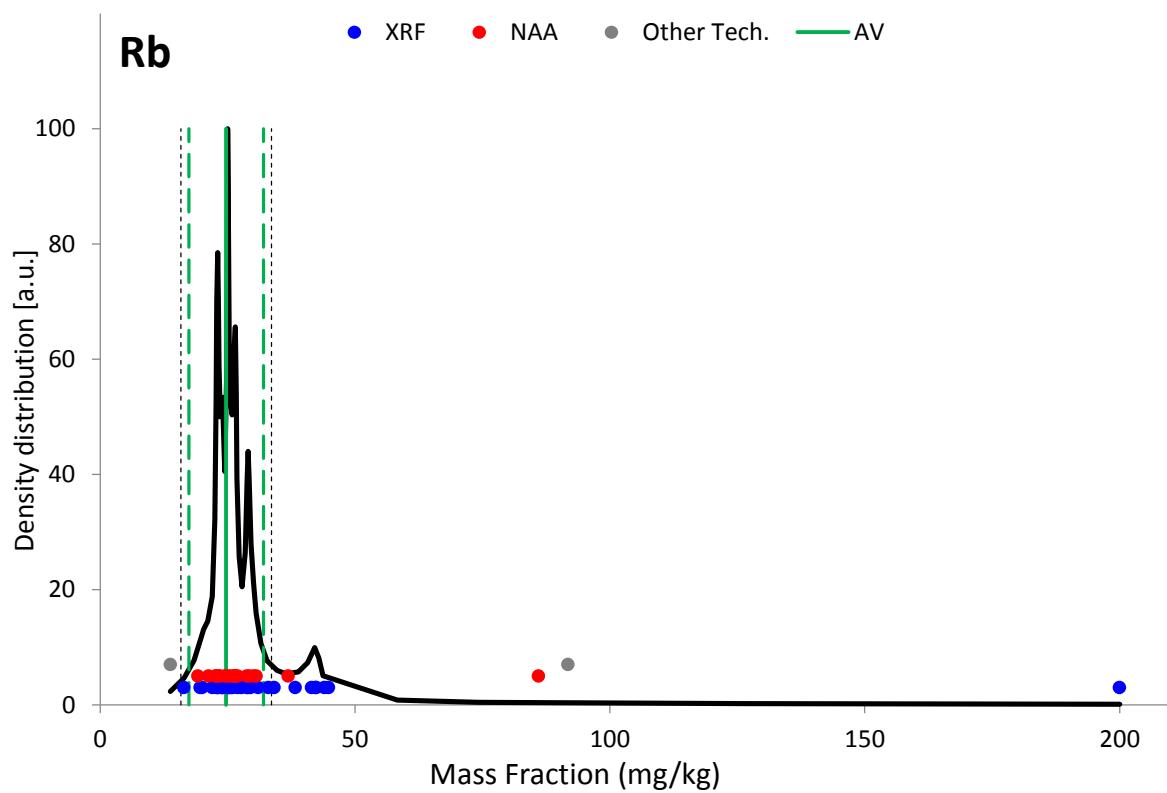


FIG. 32. Density distribution function for the measurand Rb.

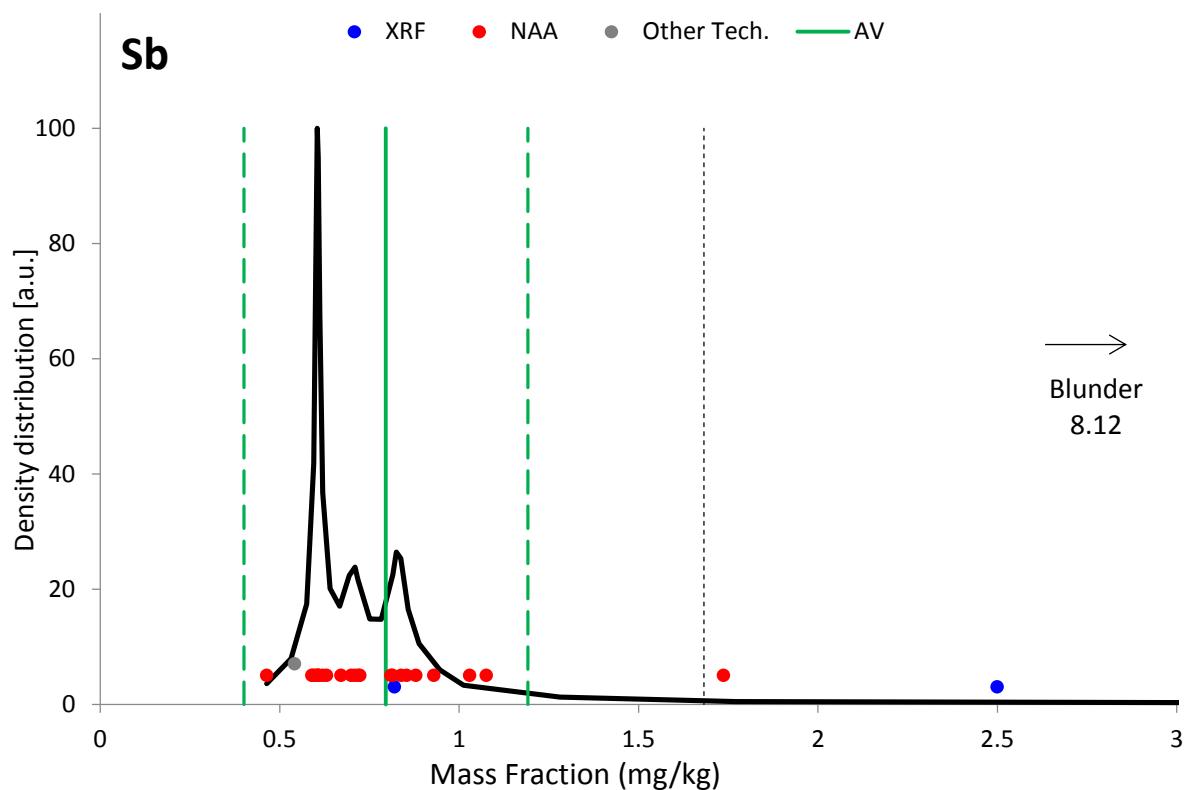


FIG. 33. Density distribution function for the measurand Sb.

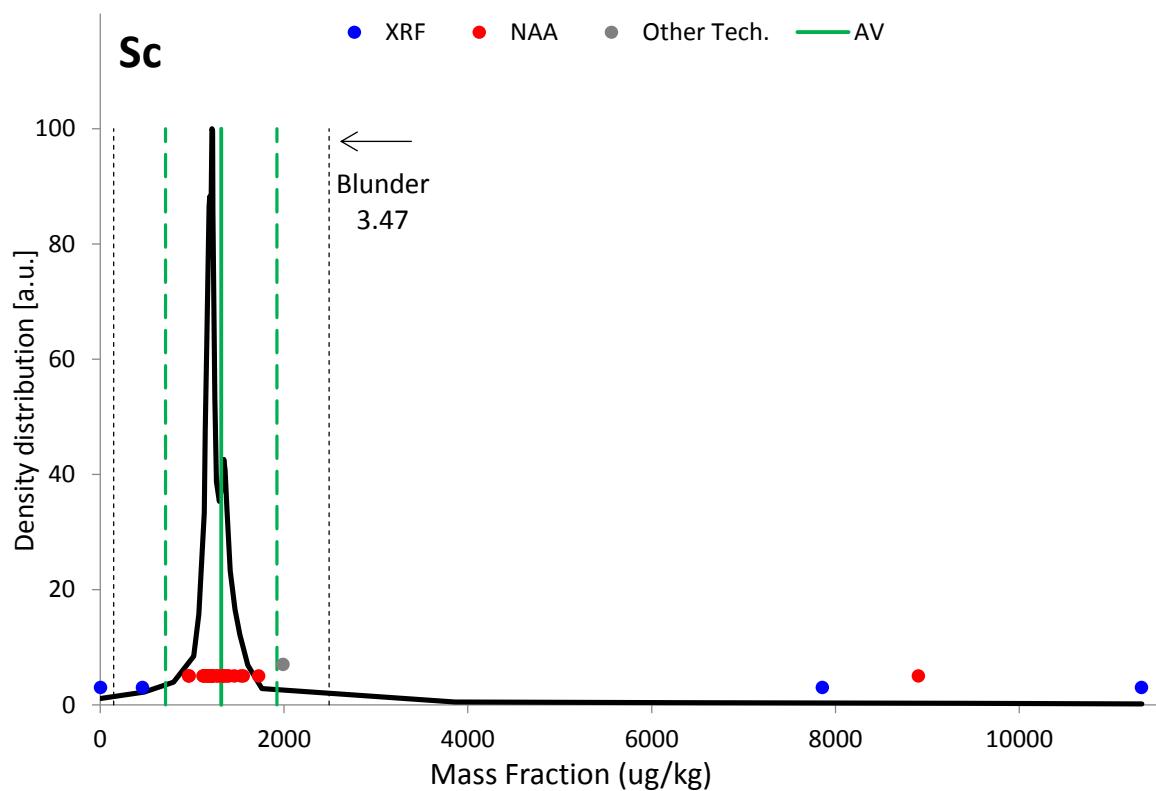


FIG. 34. Density distribution function for the measurand Sc.

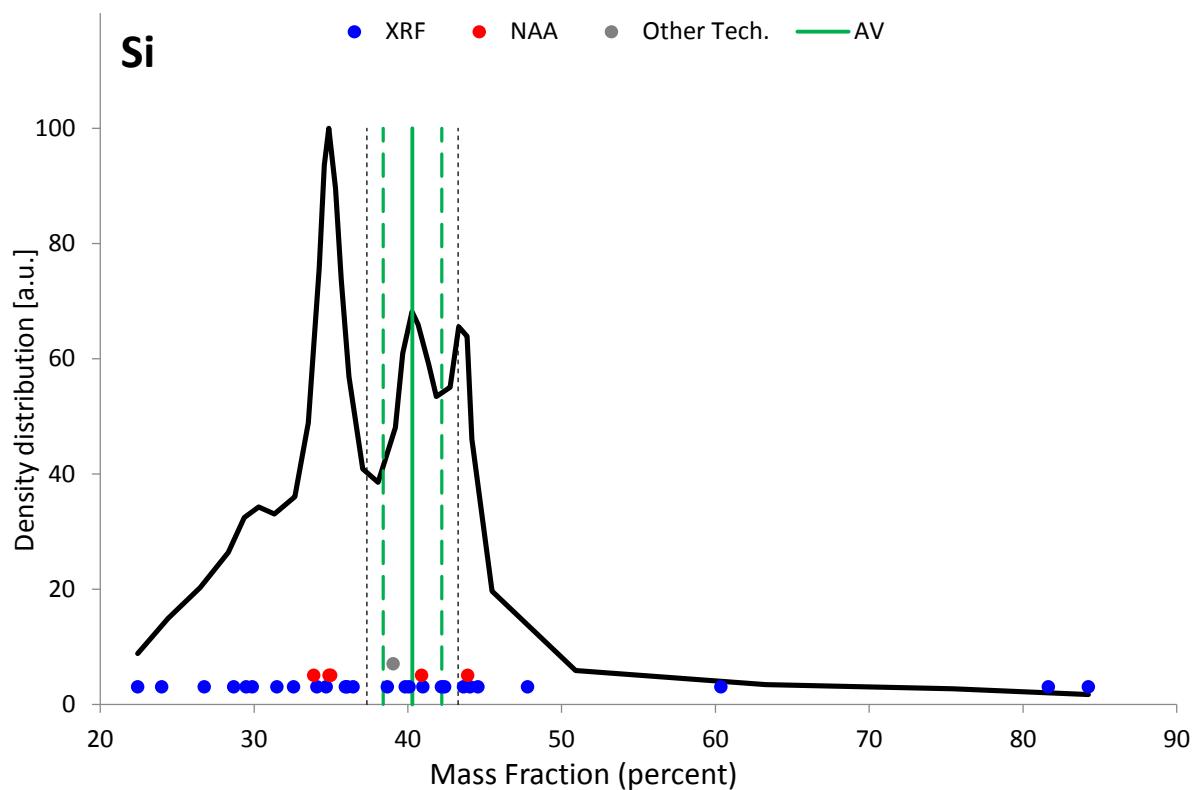


FIG. 35. Density distribution function for the measurand Si.

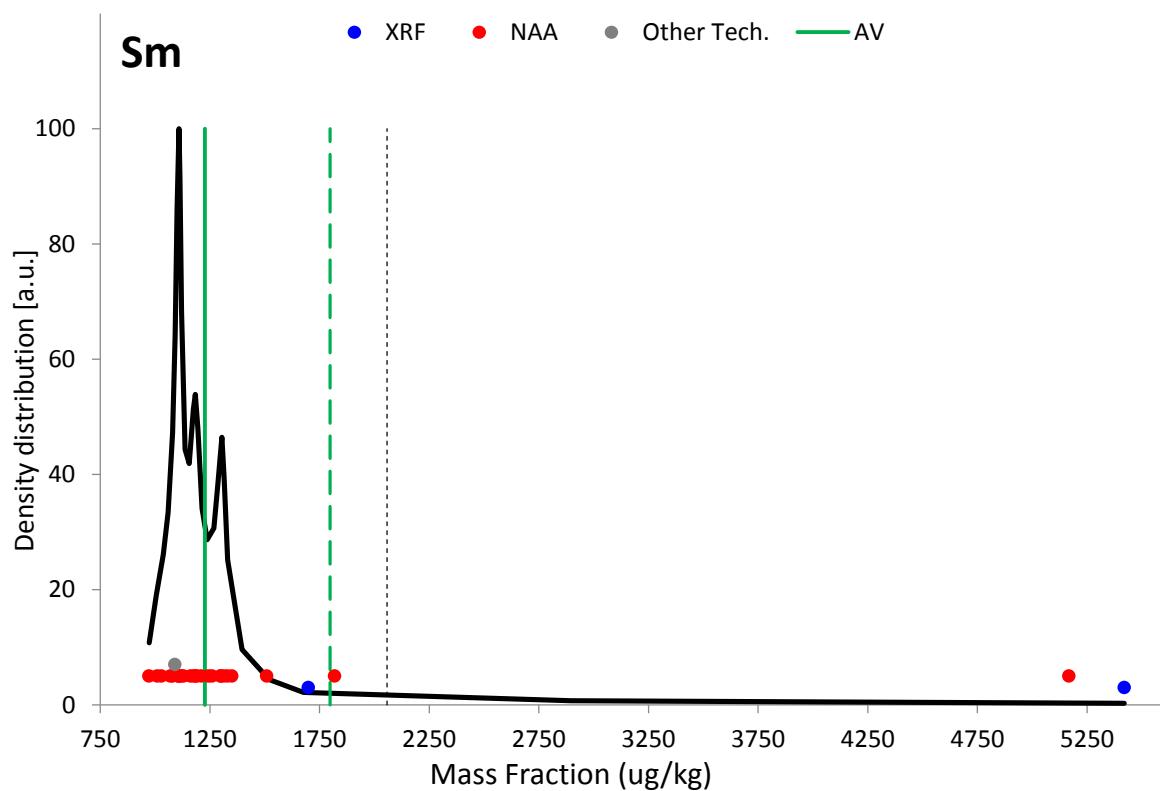


FIG. 36. Density distribution function for the measurand Sm.

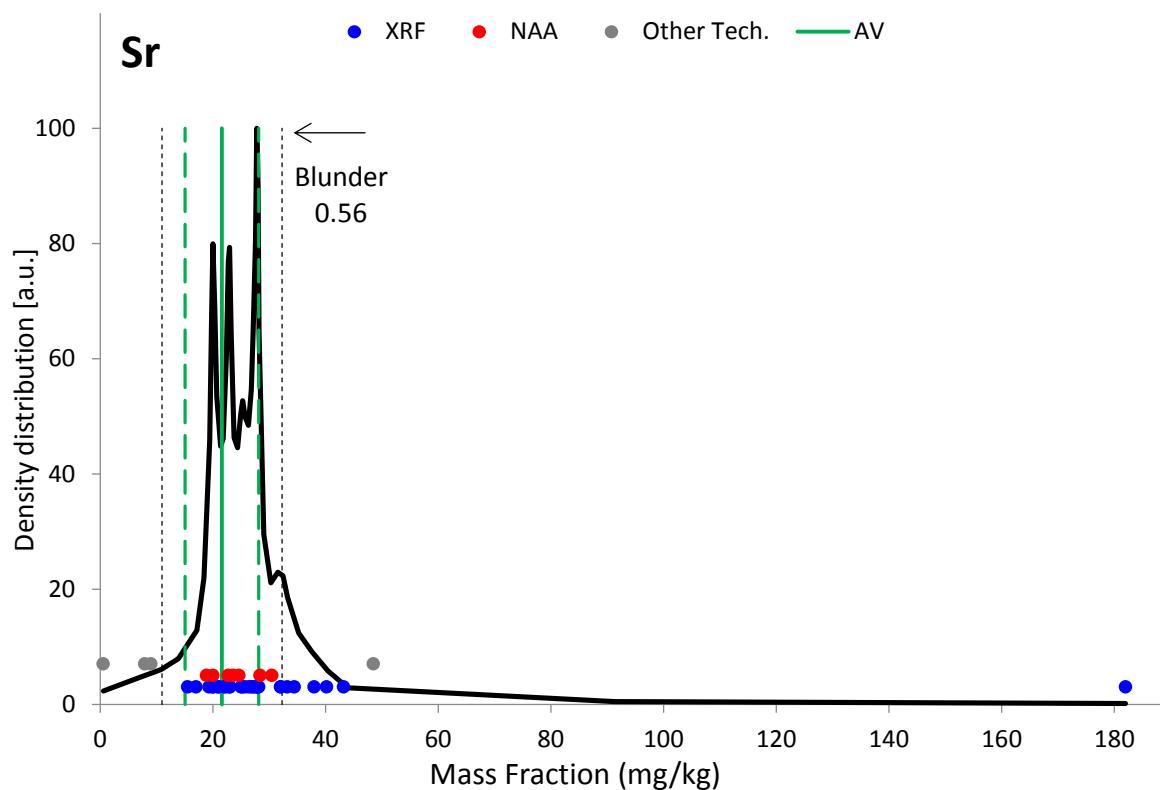


FIG. 37. Density distribution function for the measurand Sr.

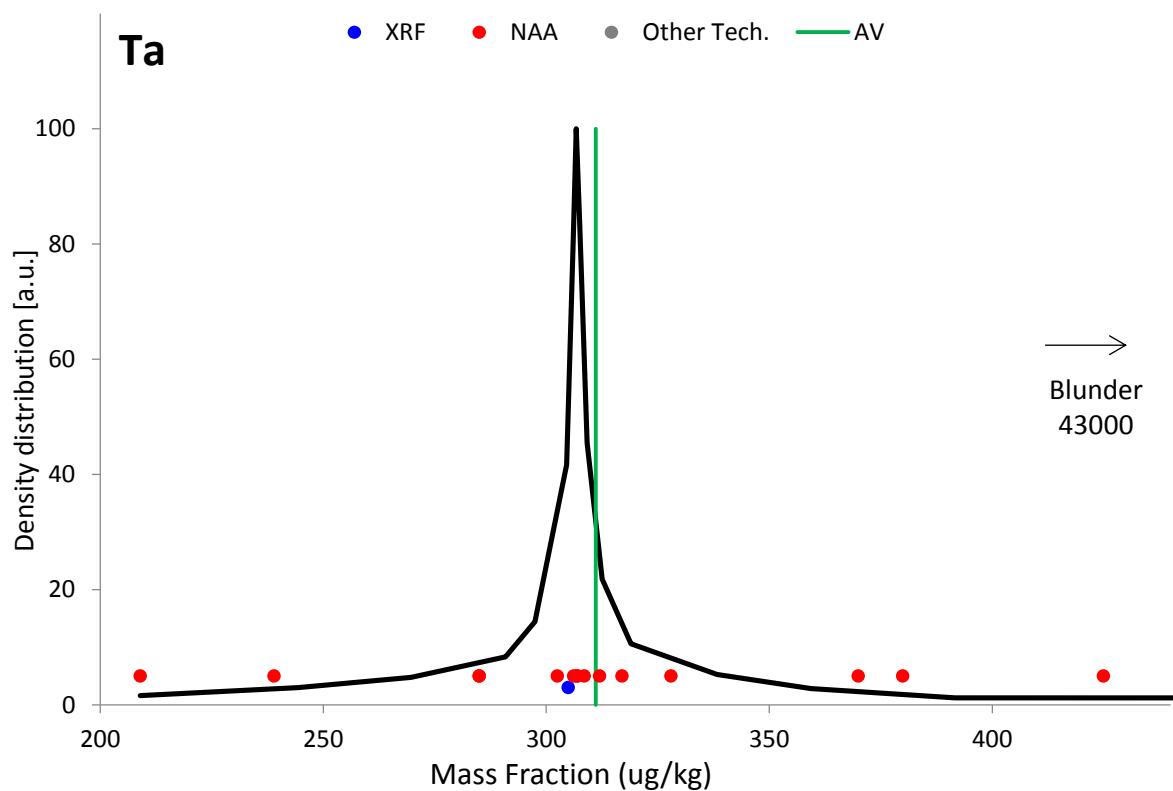


FIG. 38. Density distribution function for the measurand Ta.

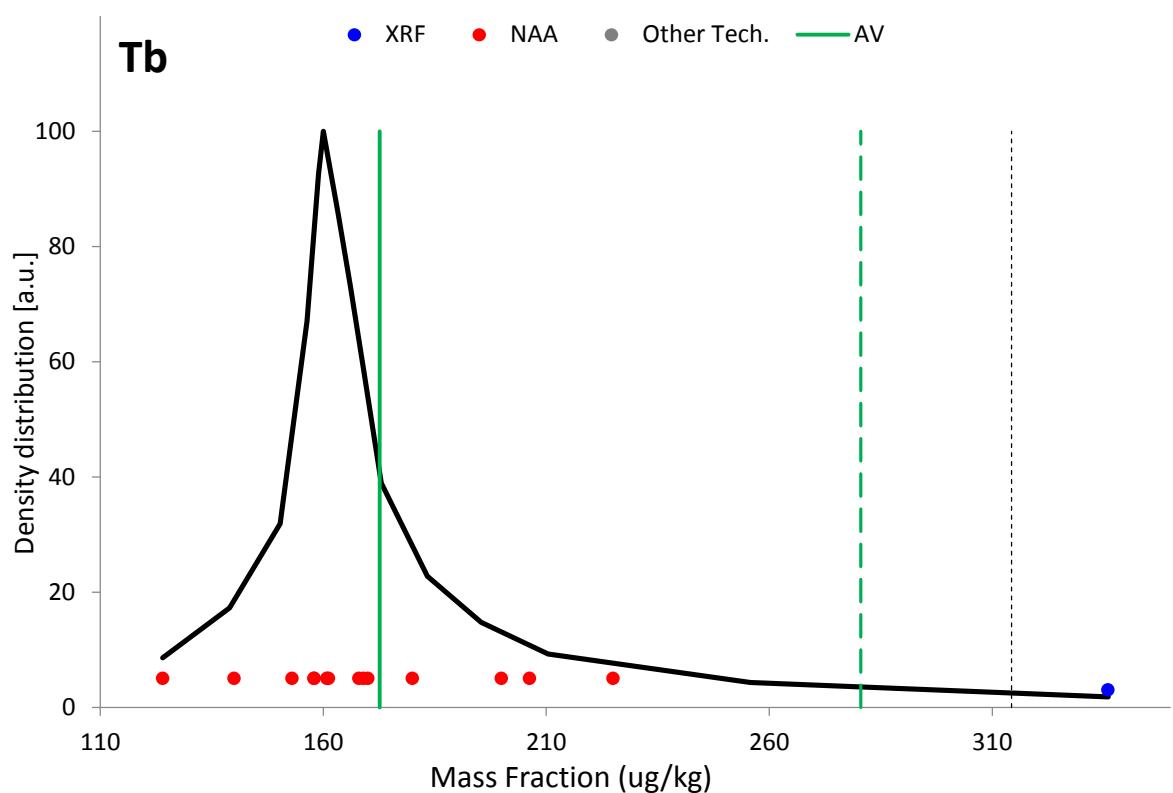


FIG. 39. Density distribution function for the measurand Tb.

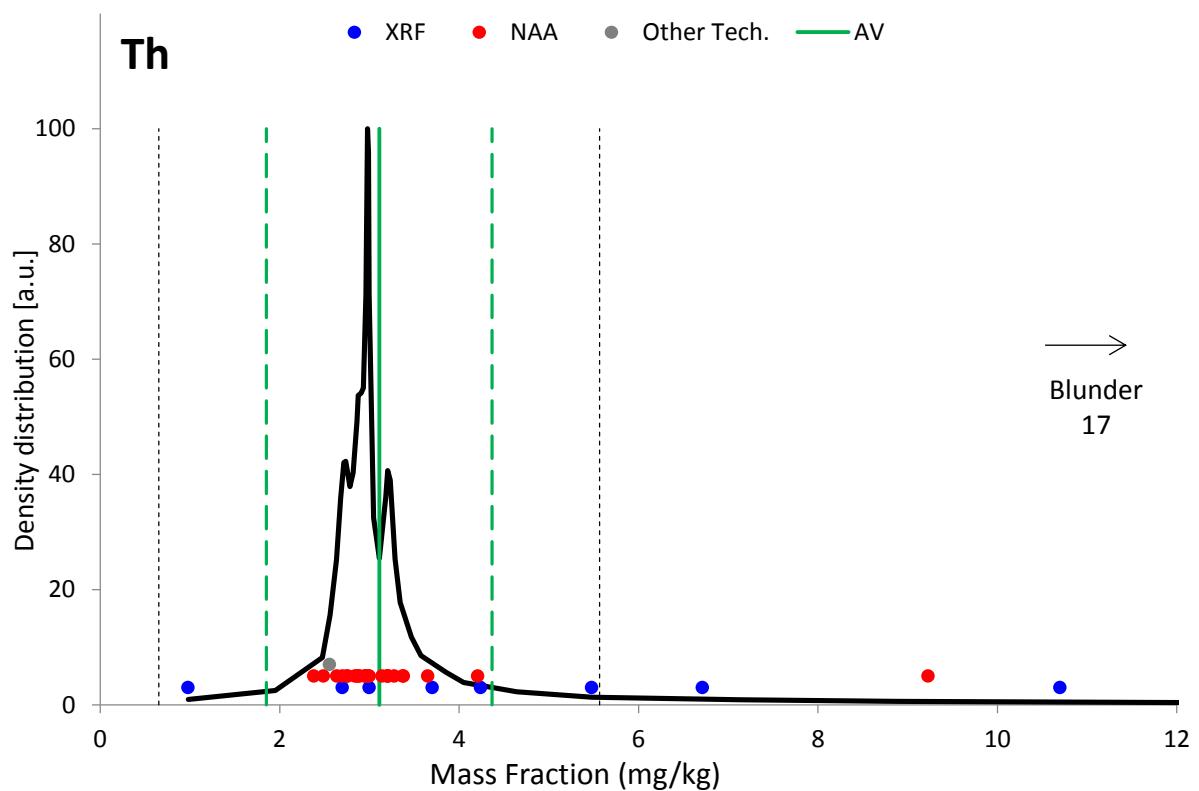


FIG. 40. Density distribution function for the measurand Th.

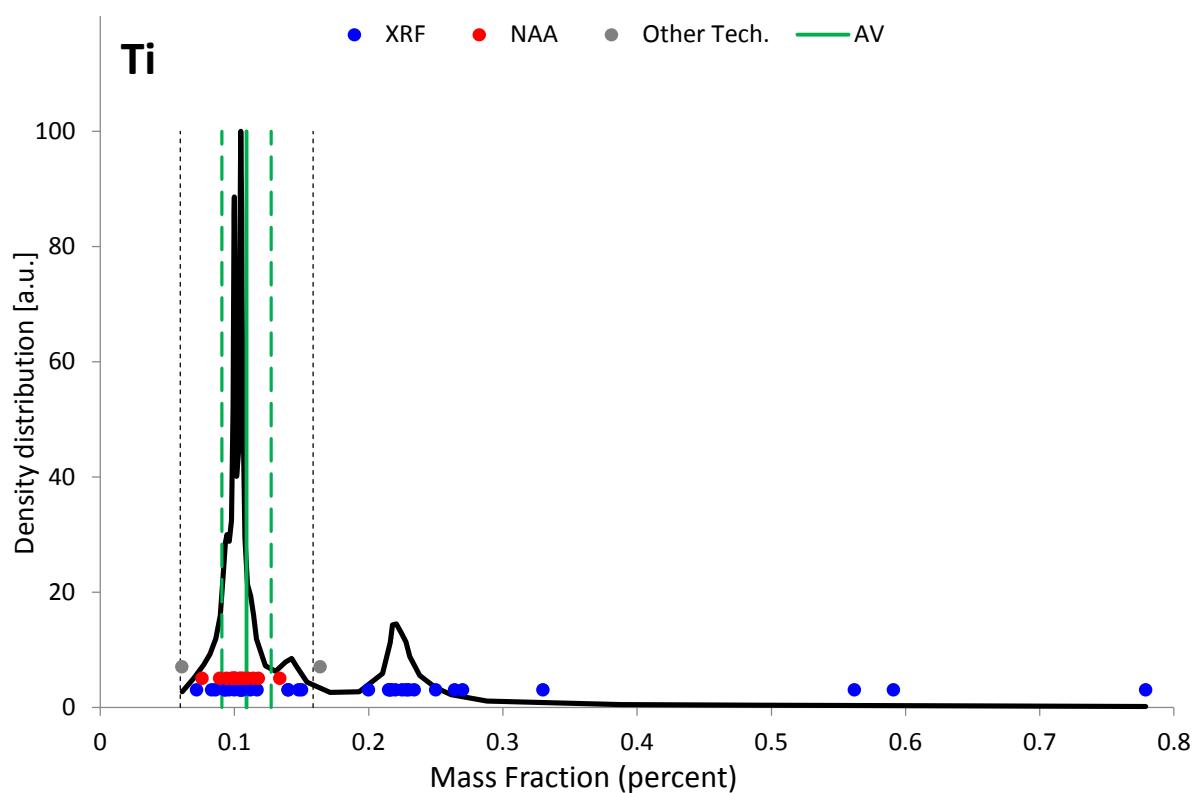


FIG. 41. Density distribution function for the measurand Ti.

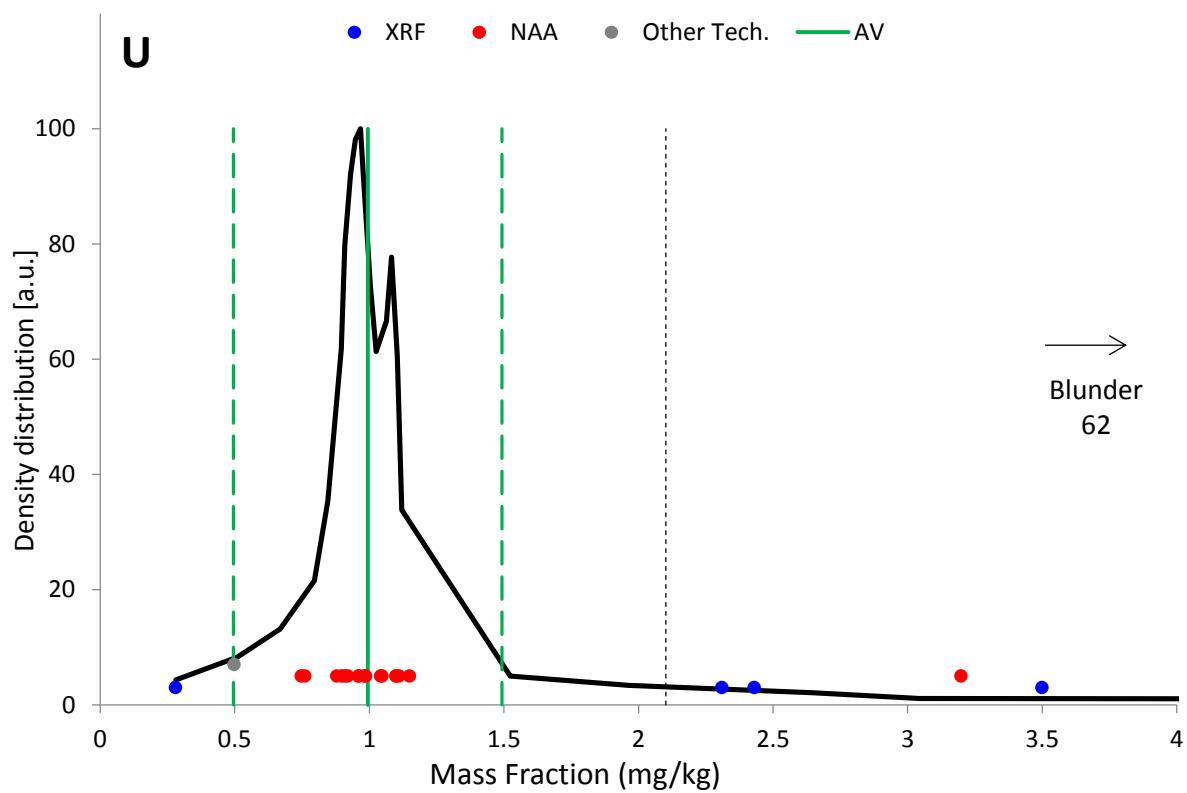


FIG. 42. Density distribution function for the measurand  $U$ .

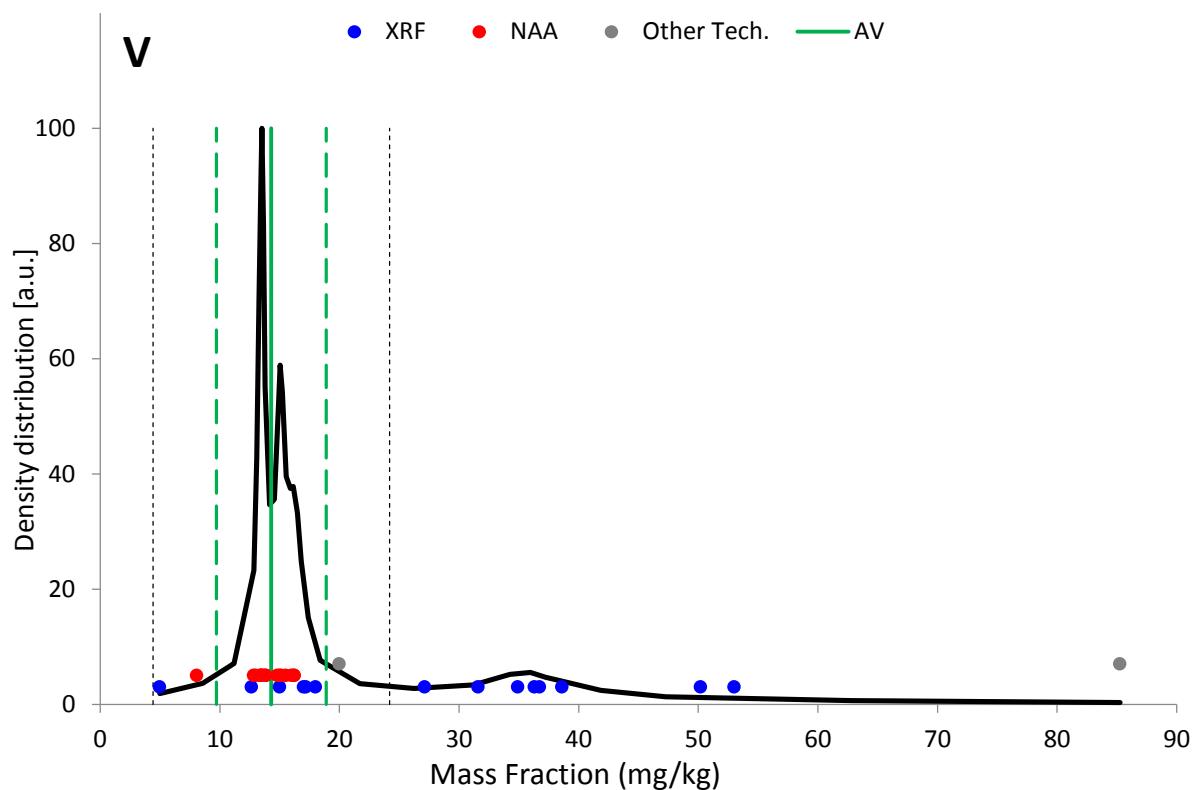


FIG. 43. Density distribution function for the measurand  $V$ .

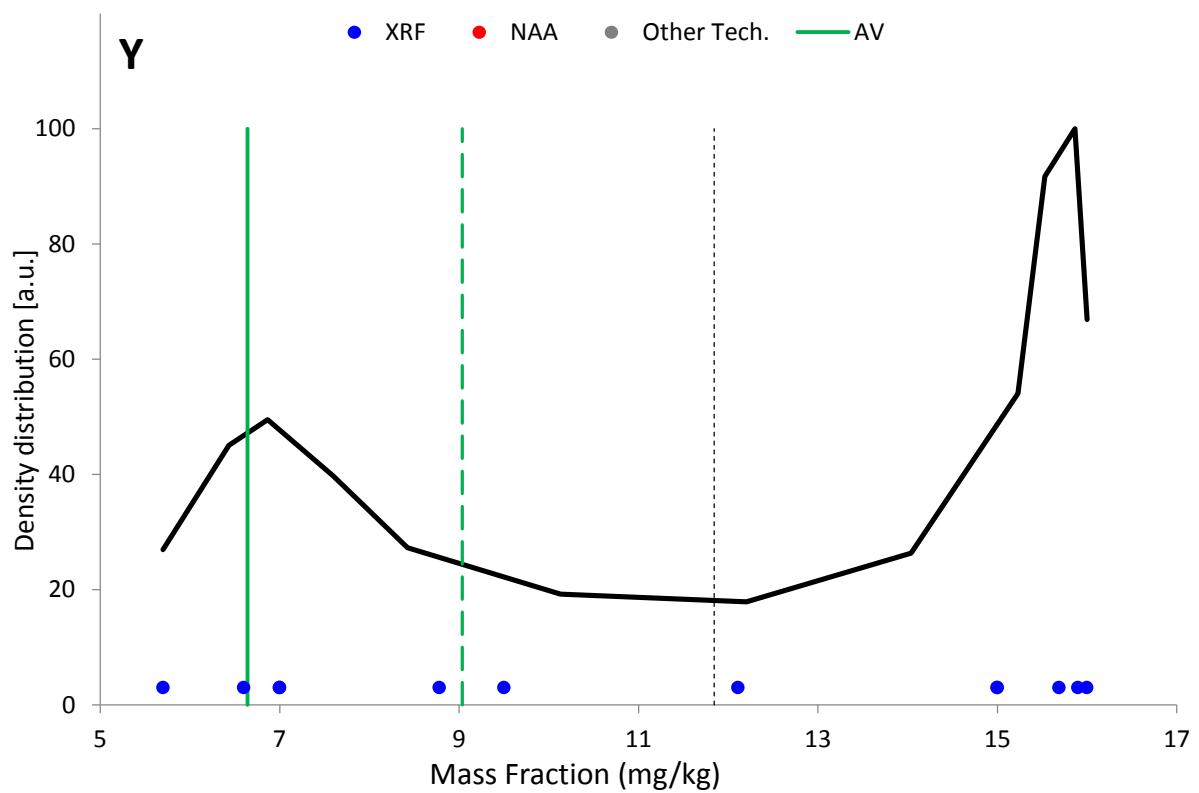


FIG. 44. Density distribution function for the measurand  $Y$ .

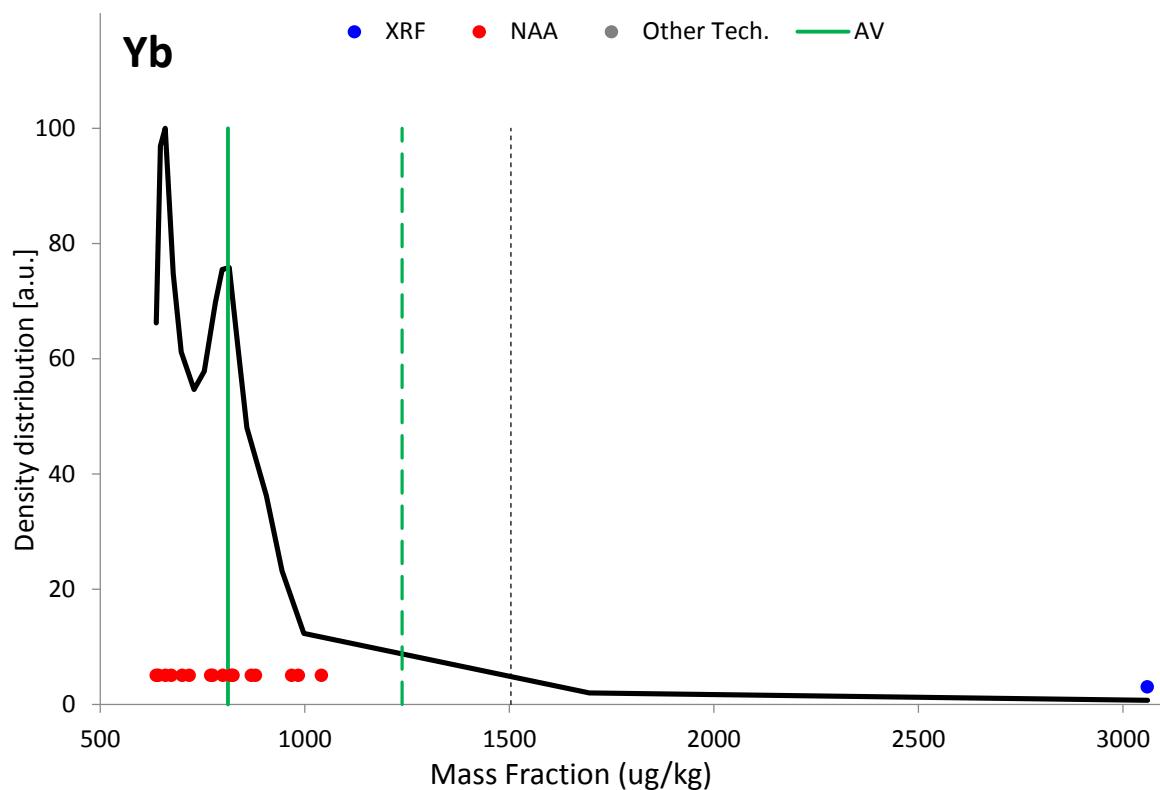


FIG. 45. Density distribution function for the measurand  $Yb$ .

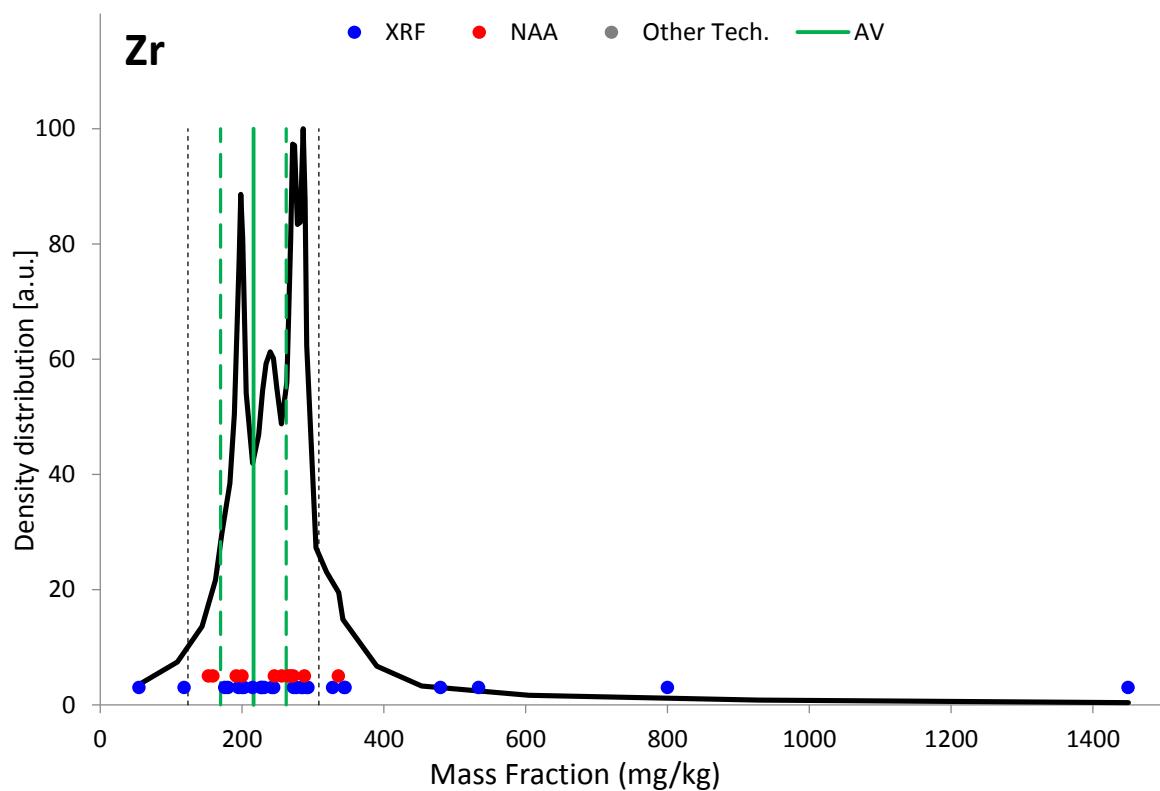


FIG. 46. Density distribution function for the measurand Zr.

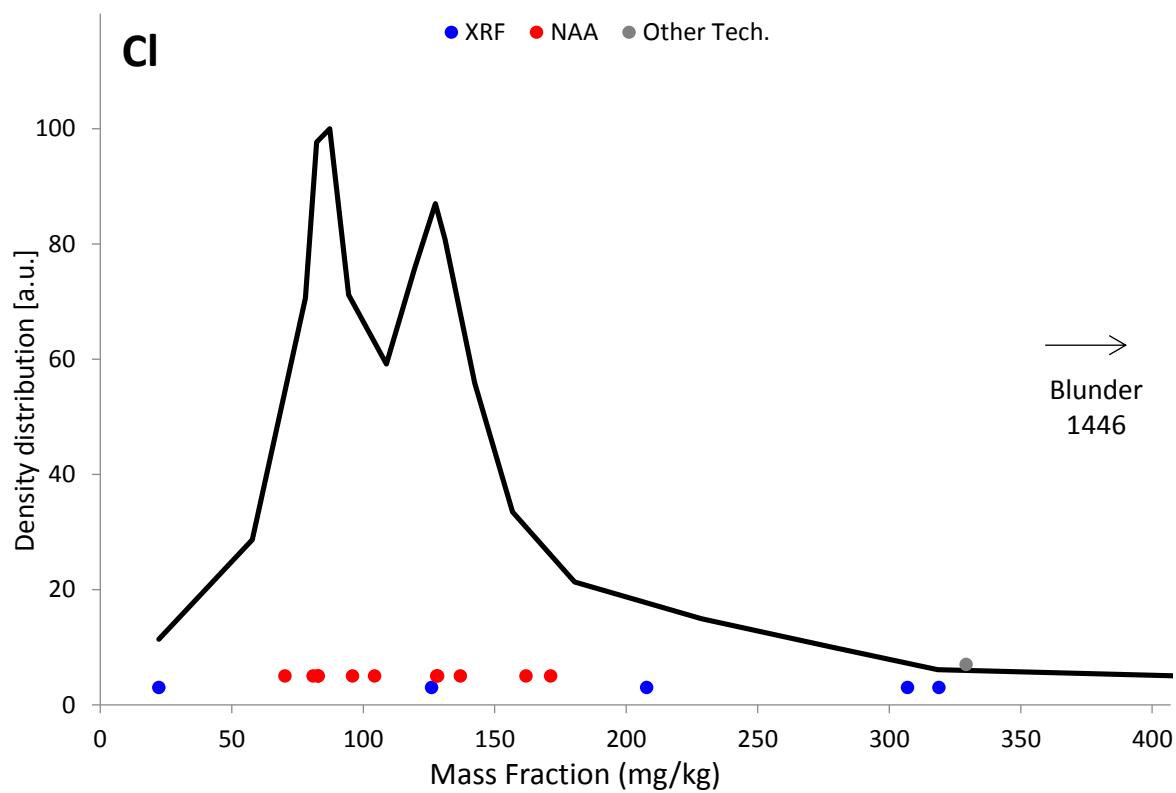


FIG. 47. Density distribution function for the measurand Cl.

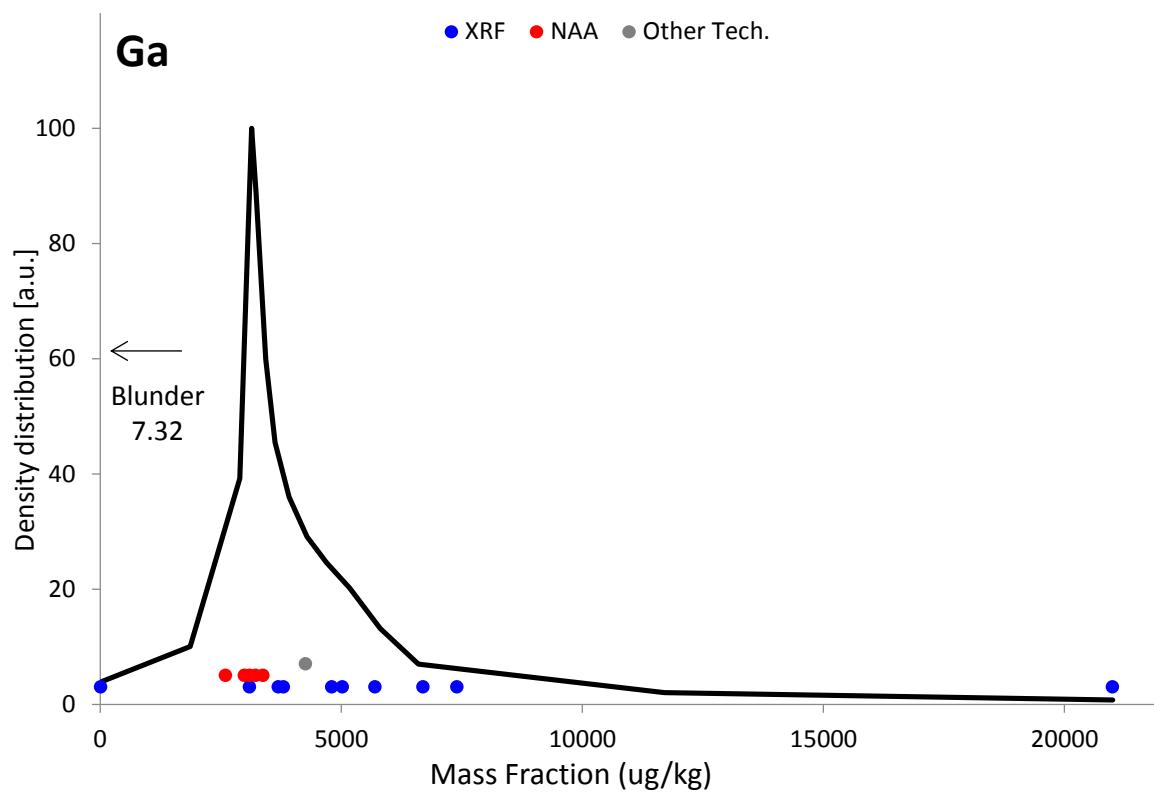
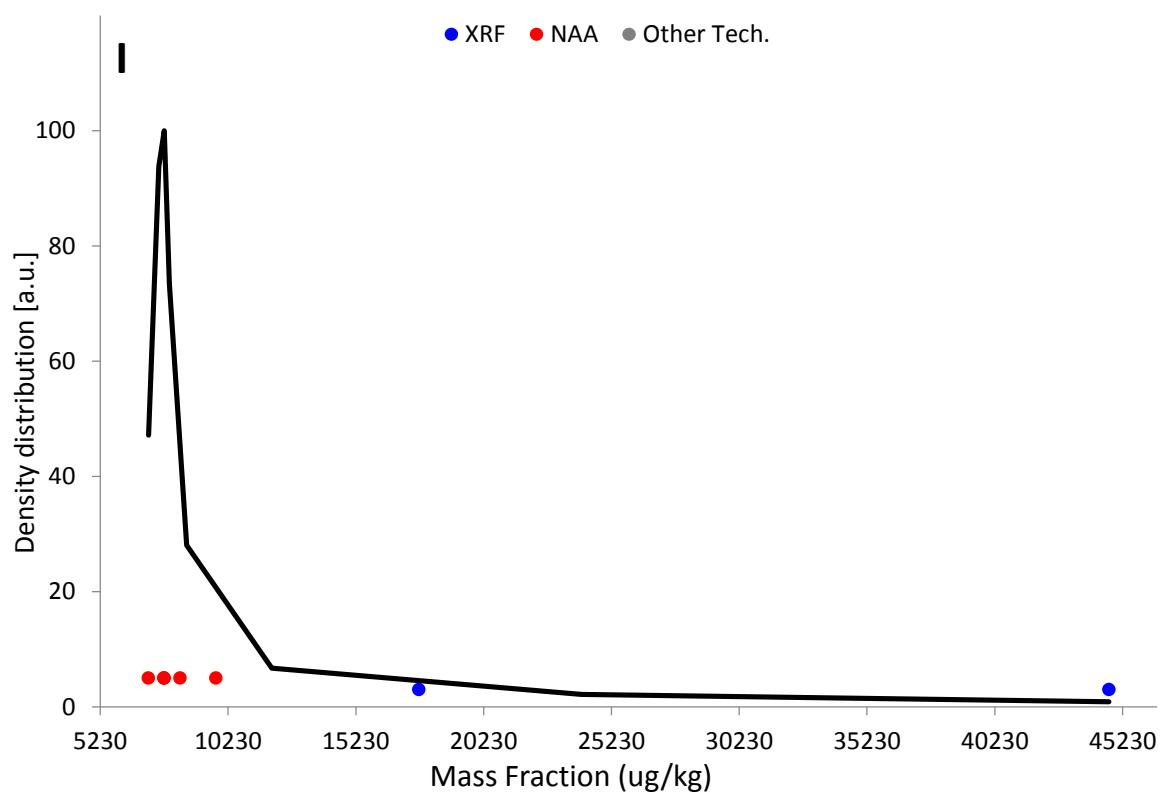
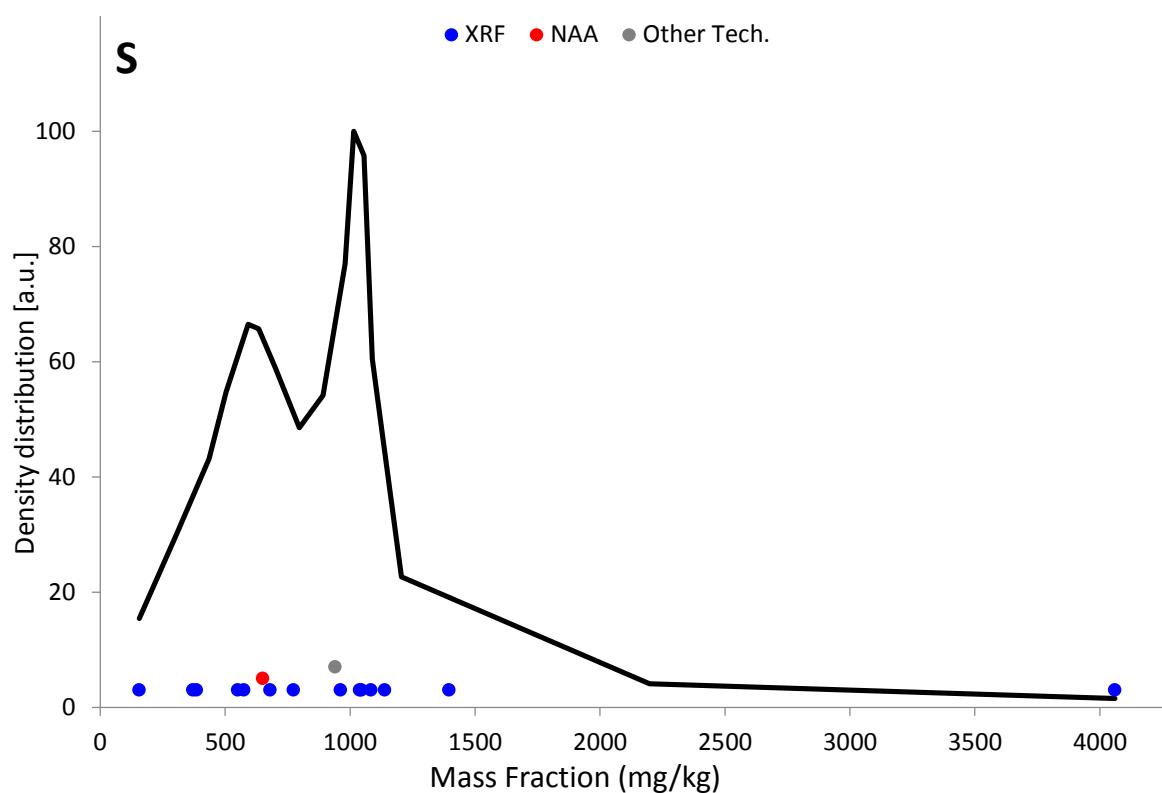


FIG. 48. Density distribution function for the measurand Ga.



*FIG. 49. Density distribution function for the measurand I.*



*FIG. 50. Density distribution function for the measurand S.*

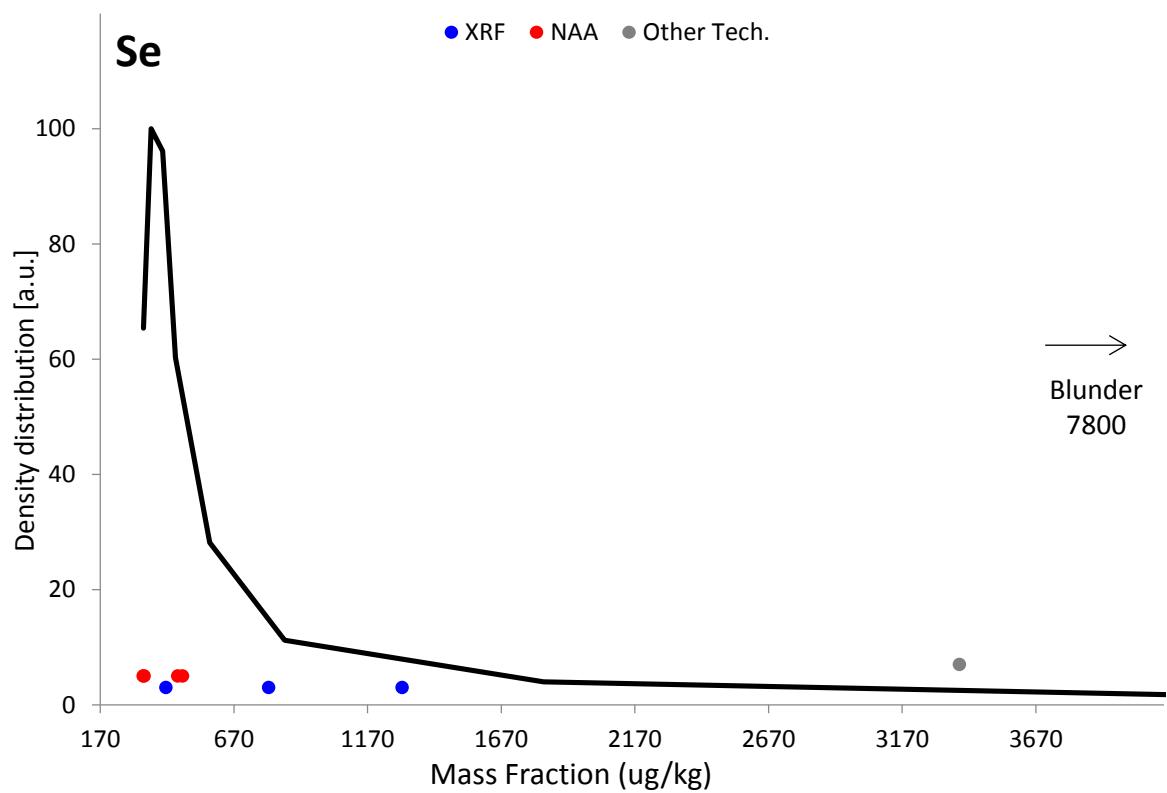


FIG. 51. Density distribution function for the measurand Se.

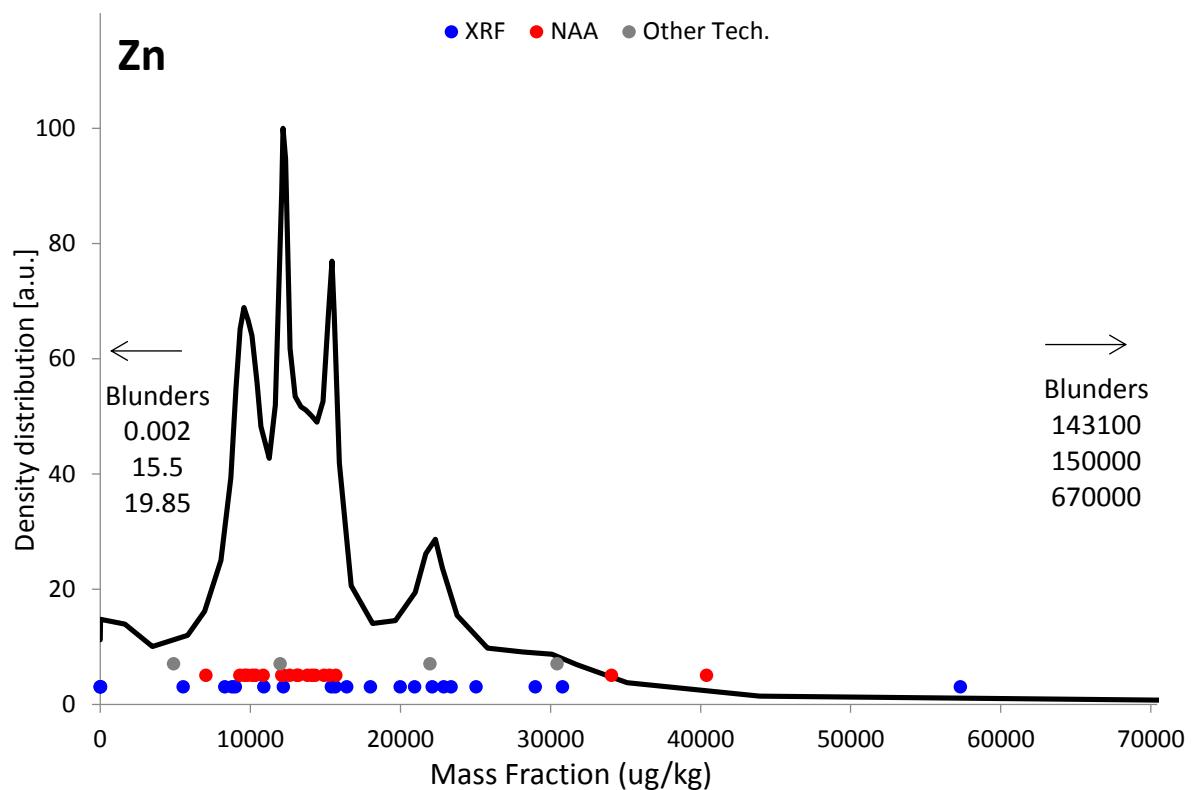


FIG. 52. Density distribution function for the measurand Zn.

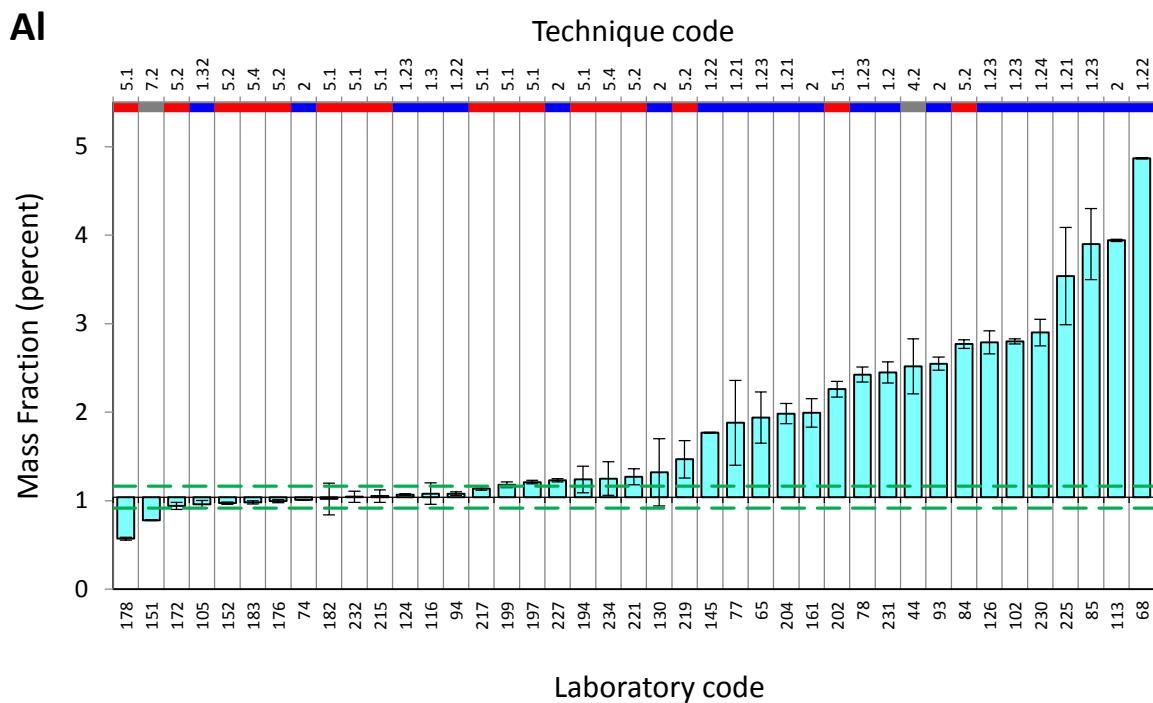
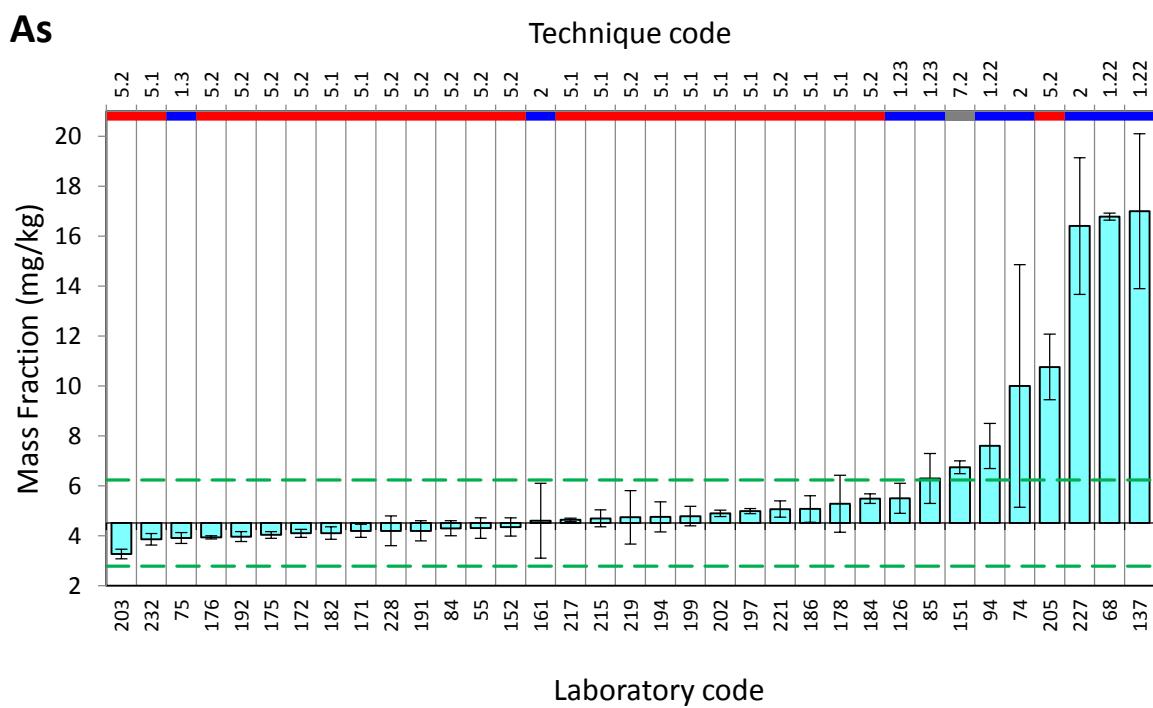
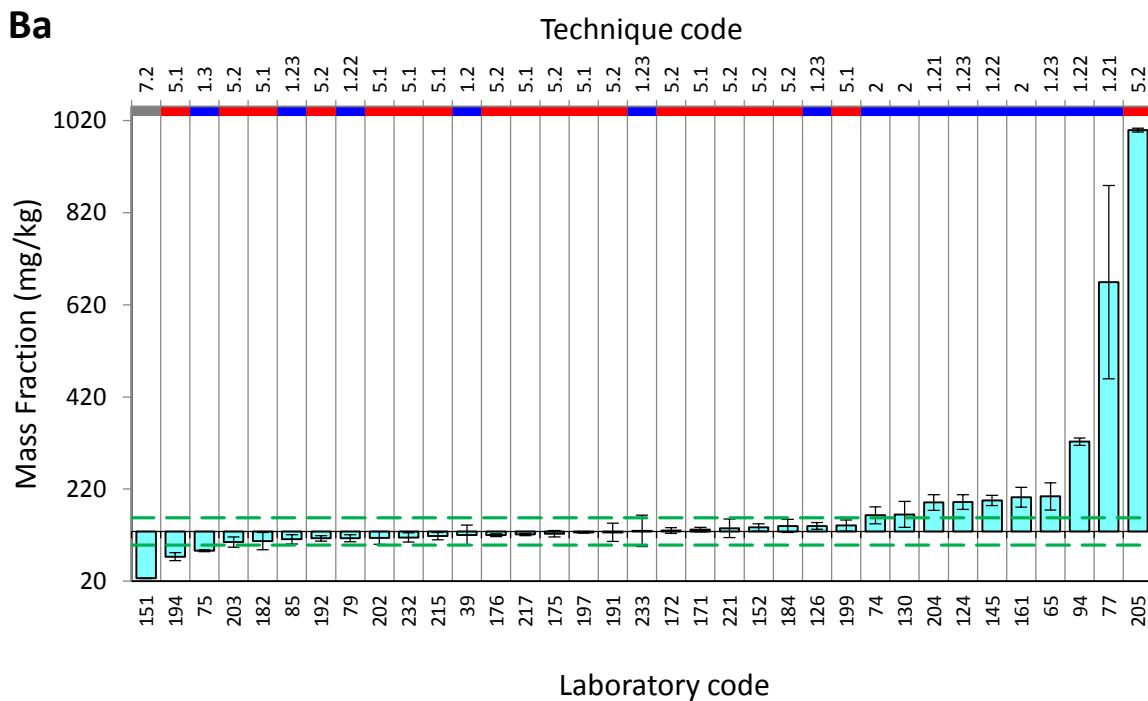


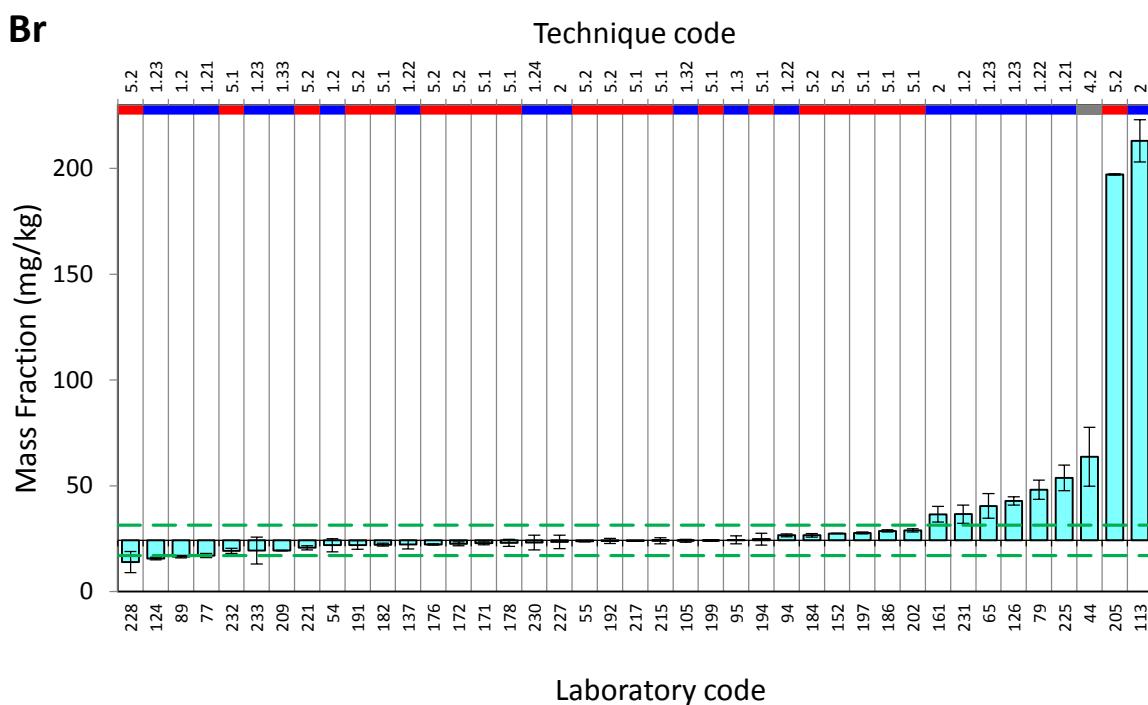
FIG. 53. Bar chart distributions of results for measurand Al.



*FIG. 54. Bar chart distributions of results for measurand As.*



*FIG. 55. Bar chart distributions of results for measurand Ba.*



*FIG. 56. Bar chart distributions of results for measurand Br.*

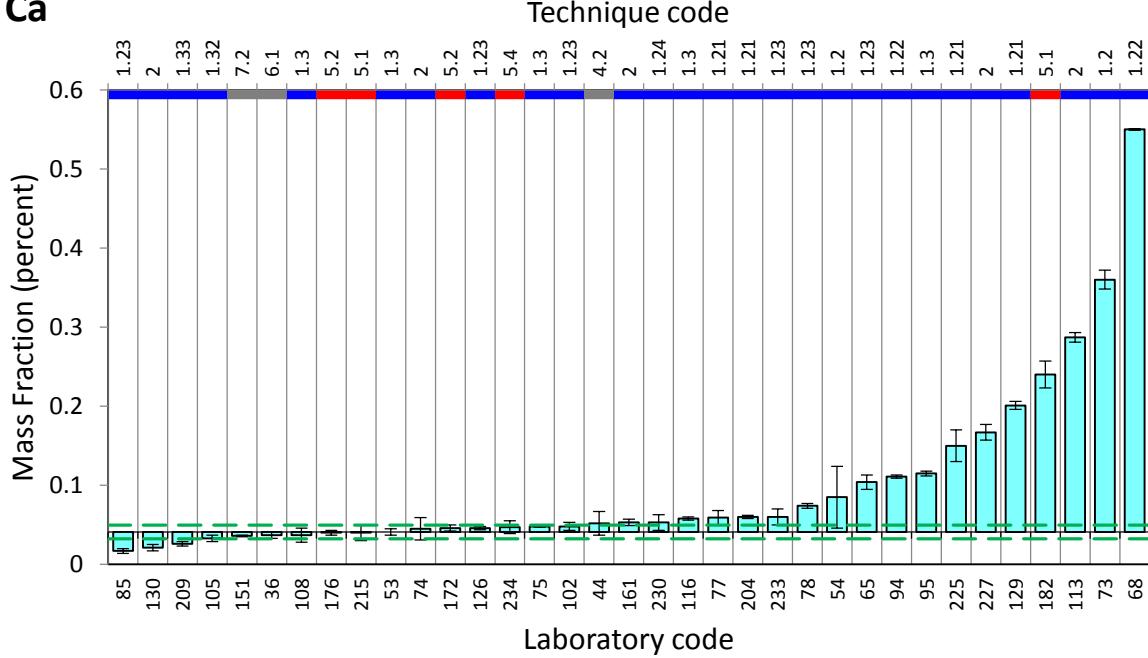
**Ca**

FIG. 57. Bar chart distributions of results for measurand Ca.

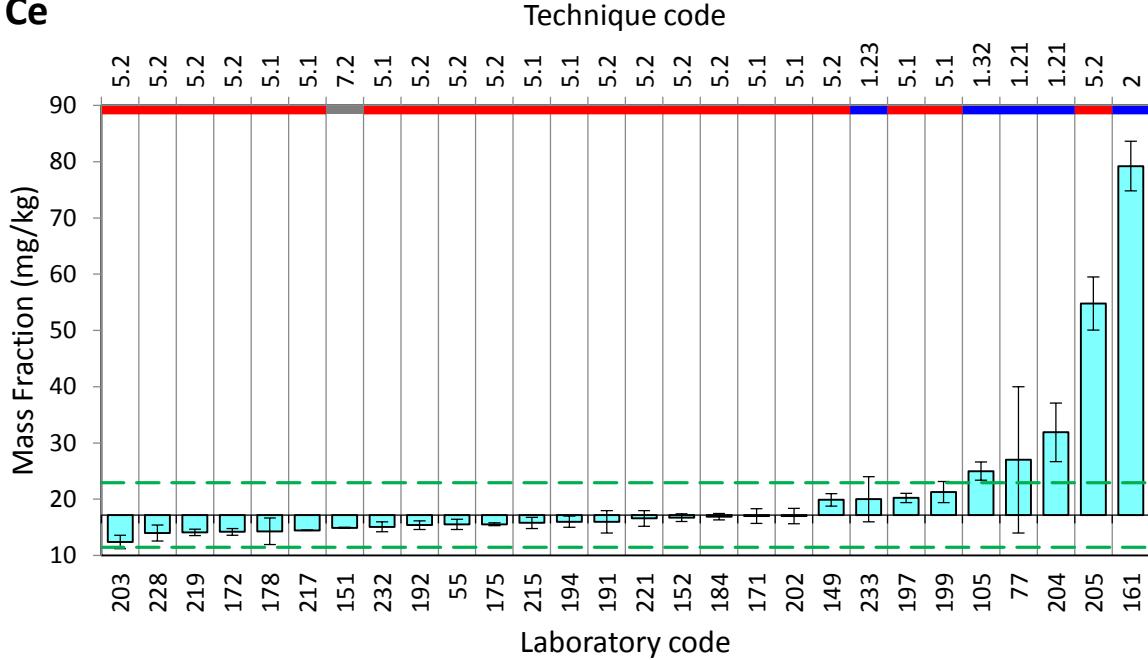
**Ce**

FIG. 58. Bar chart distributions of results for measurand Ce.

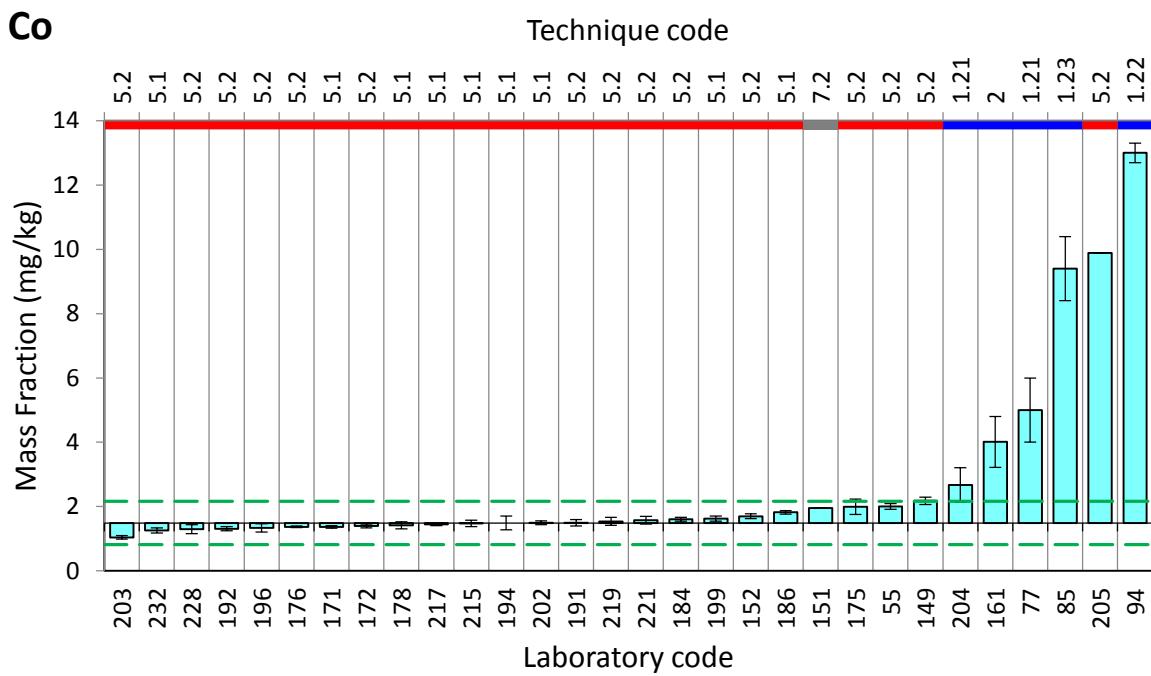


FIG. 59. Bar chart distributions of results for measurand Co.

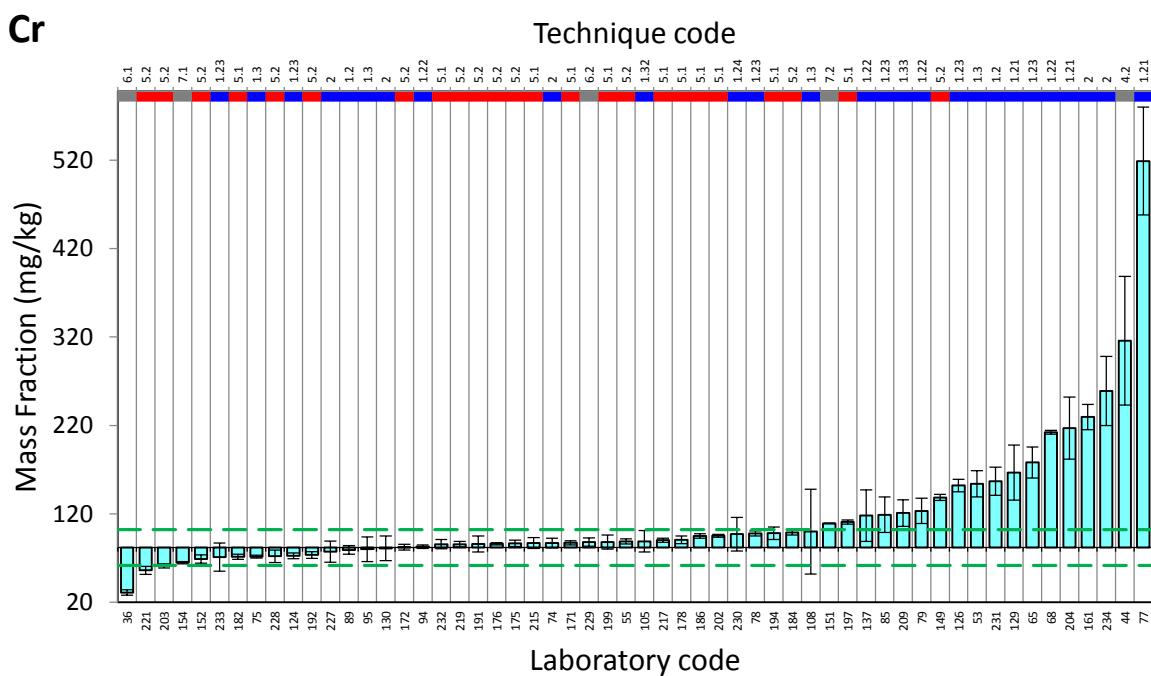
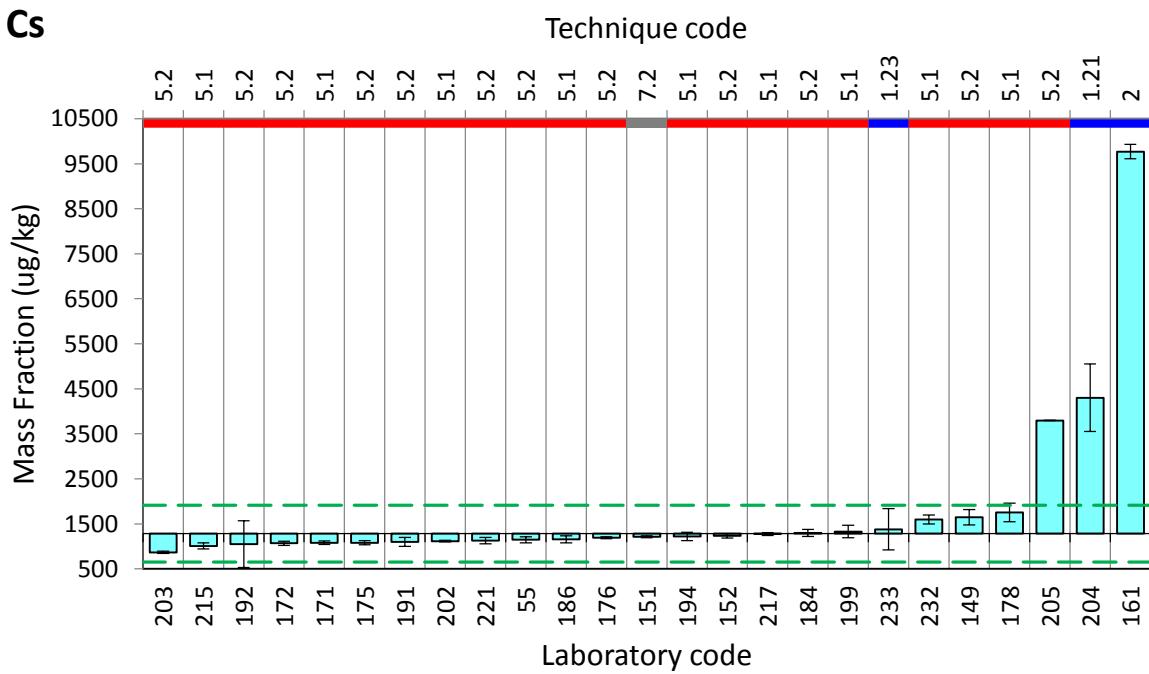
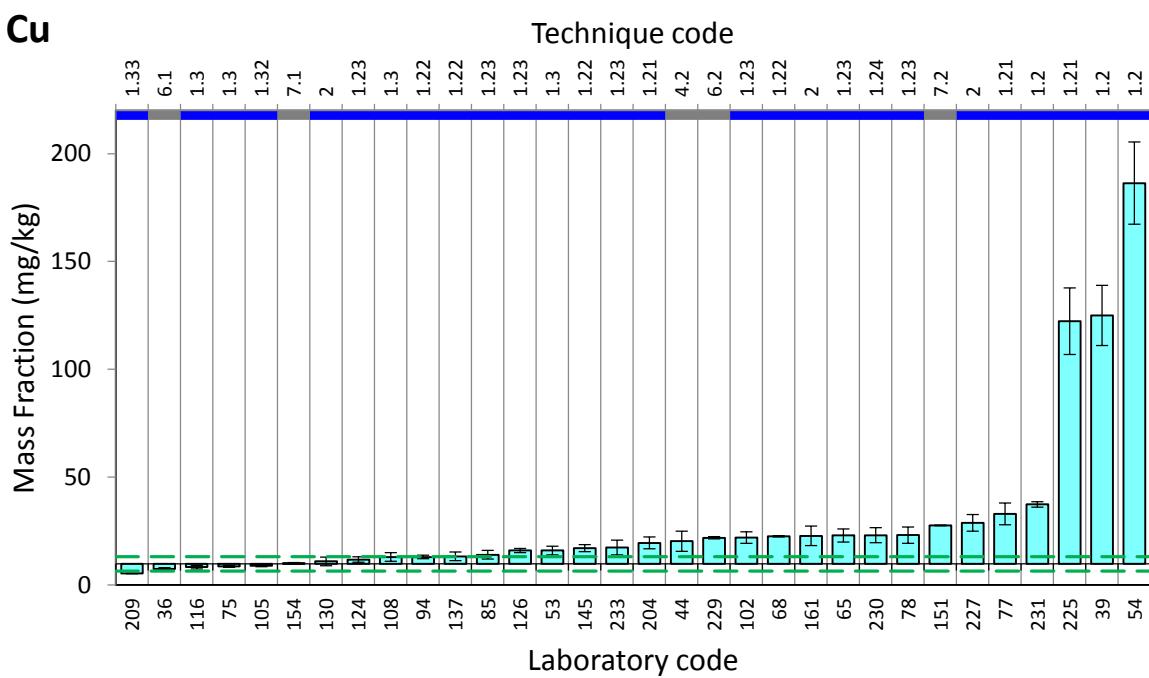


FIG. 60. Bar chart distributions of results for measurand Cr.



*FIG. 61. Bar chart distributions of results for measurand Cs.*



*FIG. 62. Bar chart distributions of results for measurand Cu.*

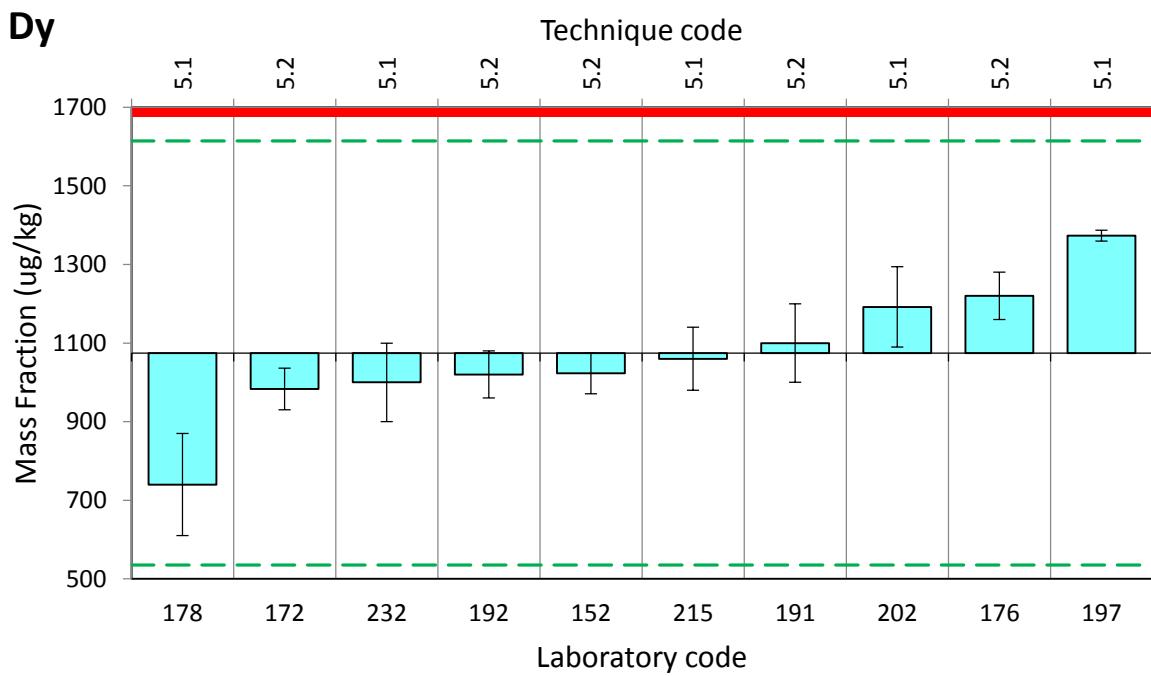


FIG. 63. Bar chart distributions of results for measurand Dy.

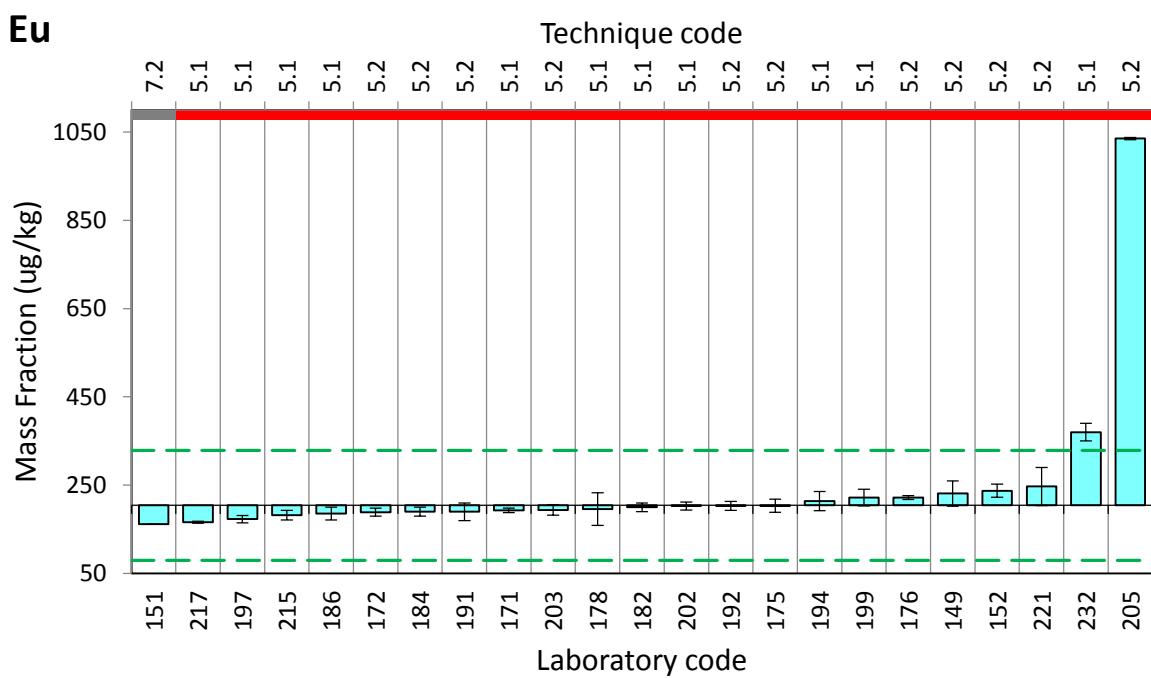


FIG. 64. Bar chart distributions of results for measurand Eu.

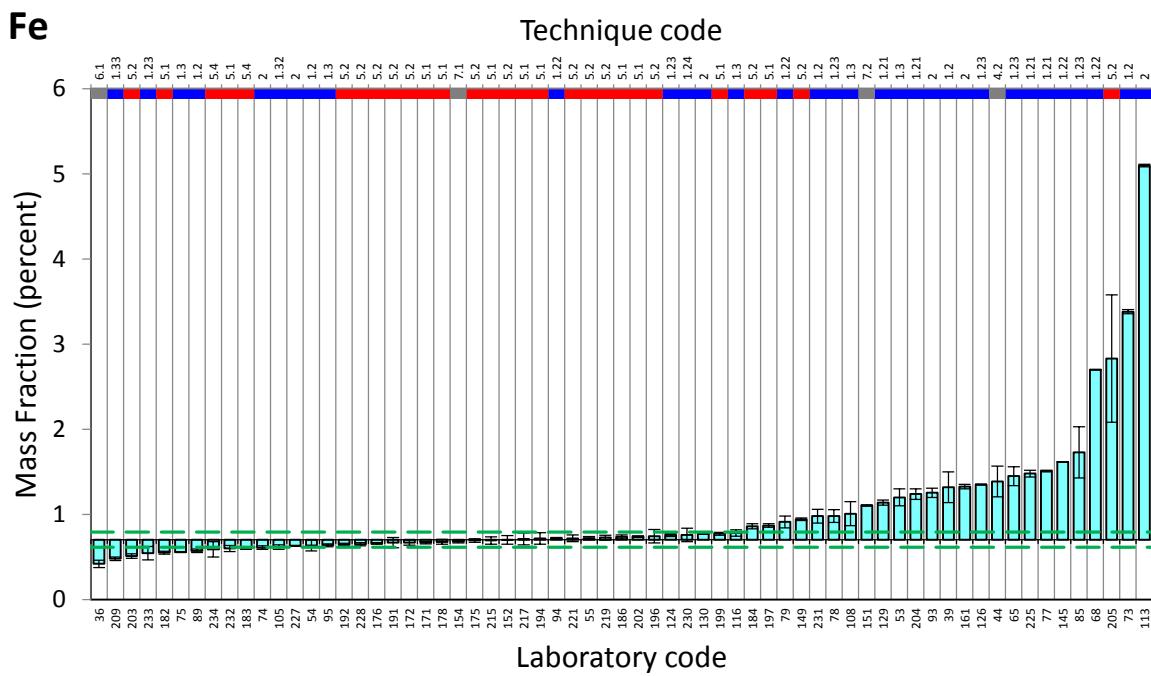


FIG. 65. Bar chart distributions of results for measurand Fe.

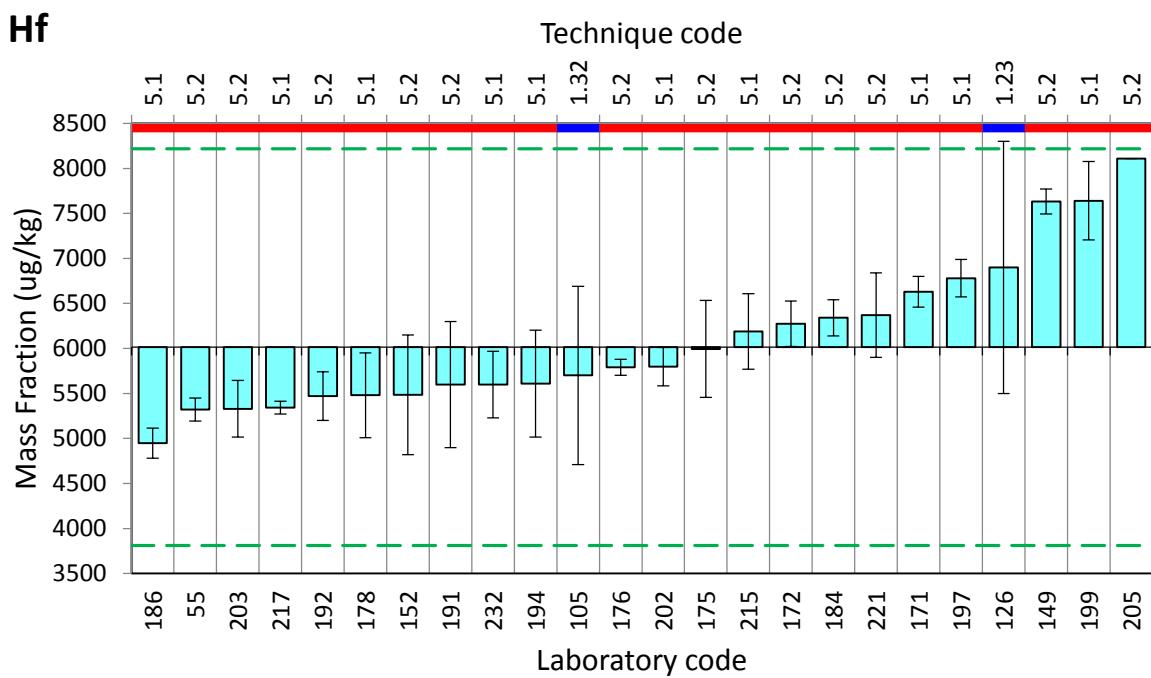


FIG. 66. Bar chart distributions of results for measurand Hf.

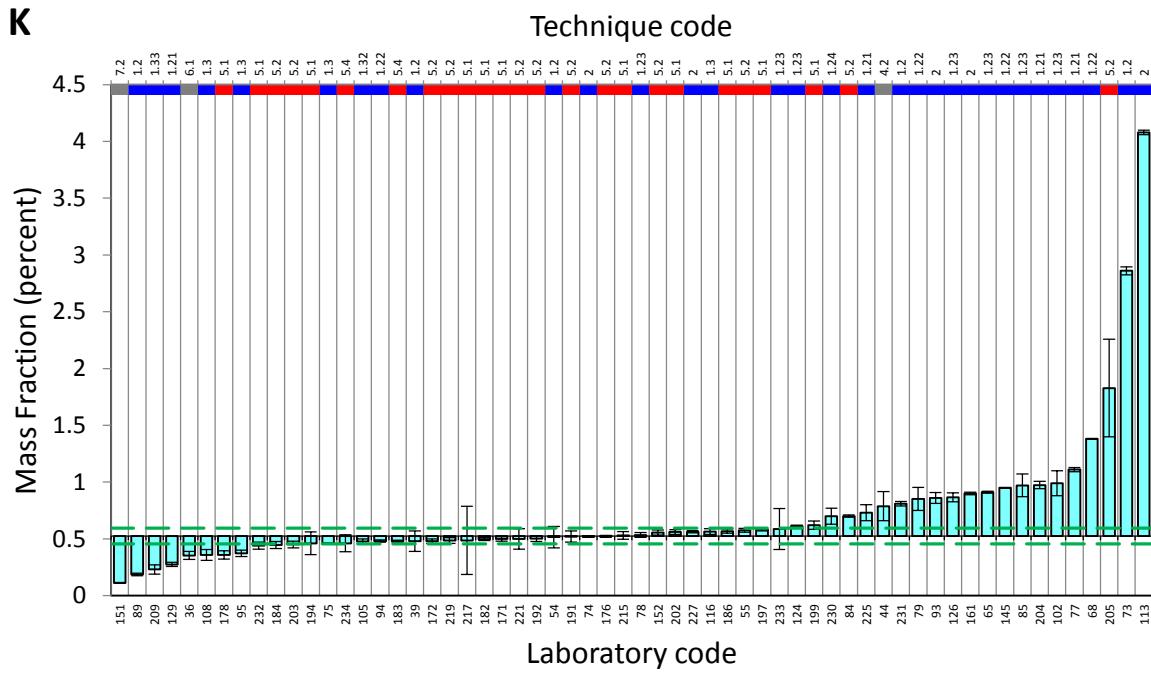


FIG. 67. Bar chart distributions of results for measurand K.

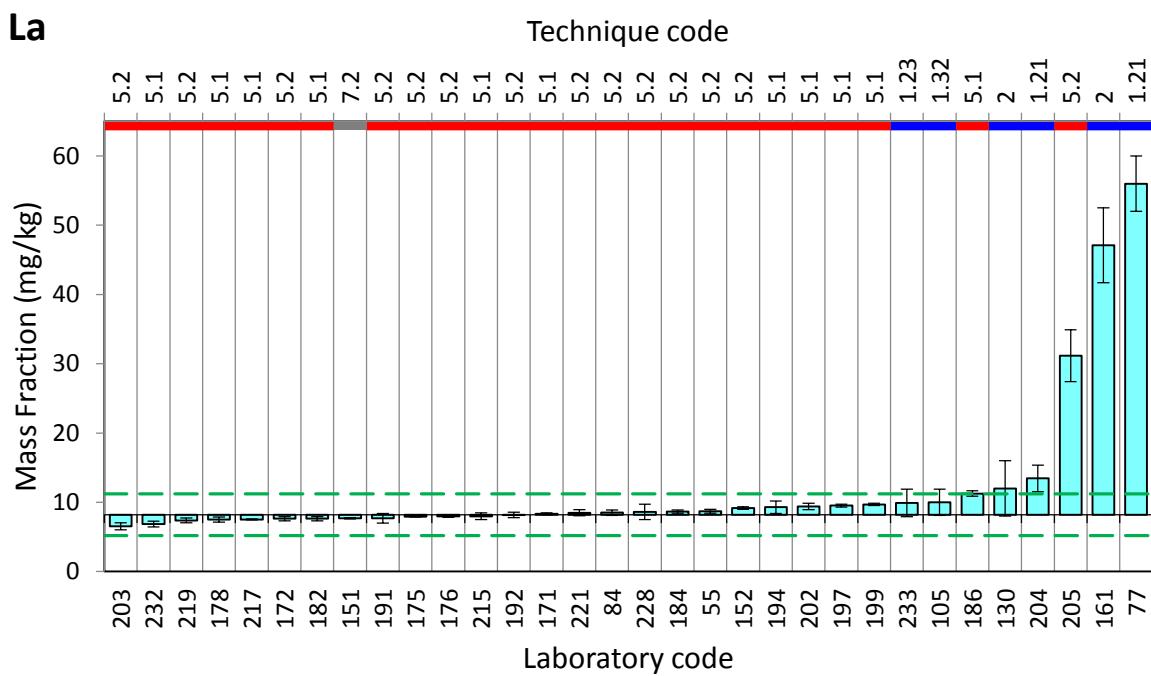


FIG. 68. Bar chart distributions of results for measurand La.

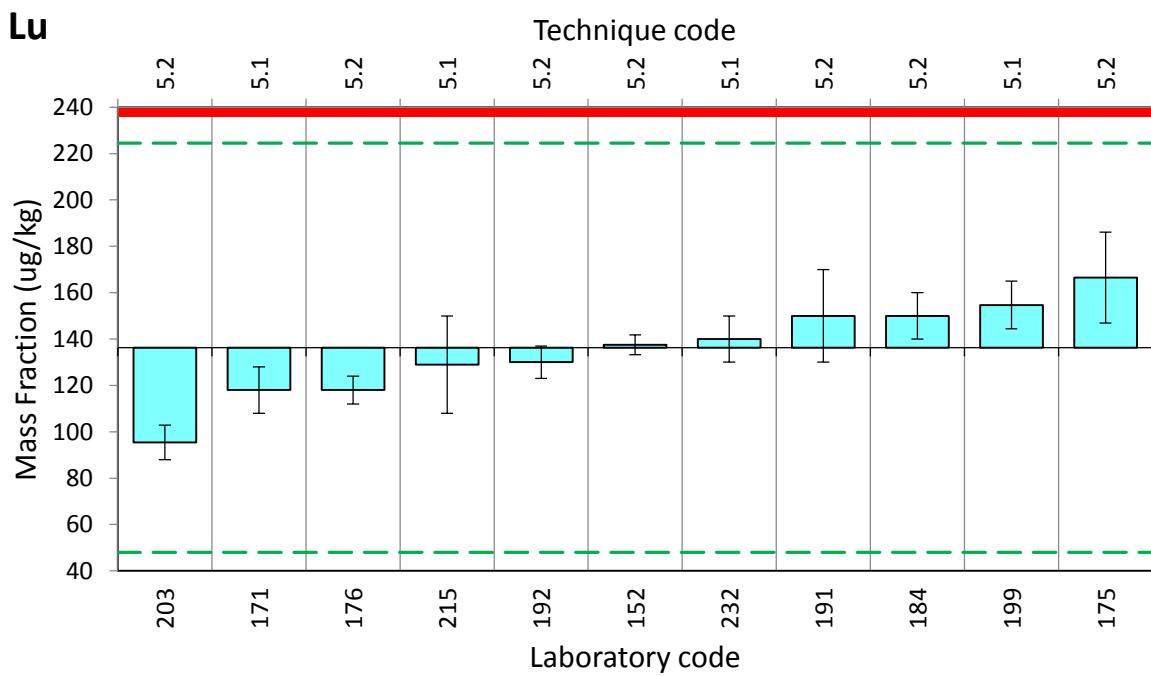


FIG. 69. Bar chart distributions of results for measurand Lu.

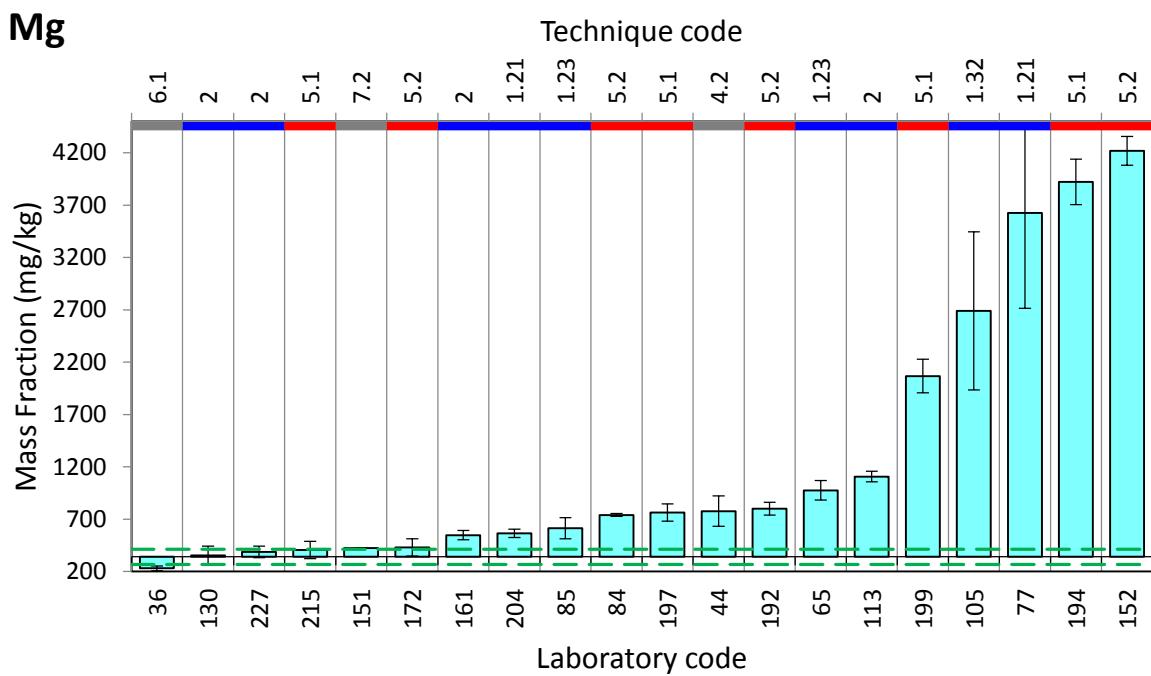
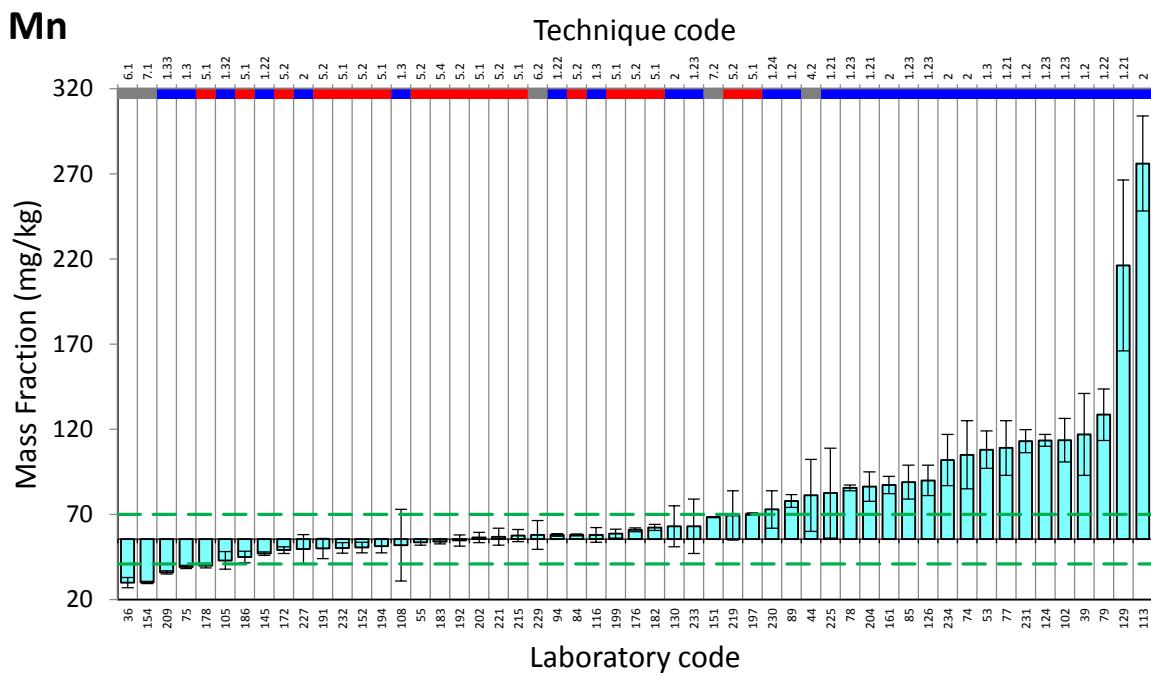
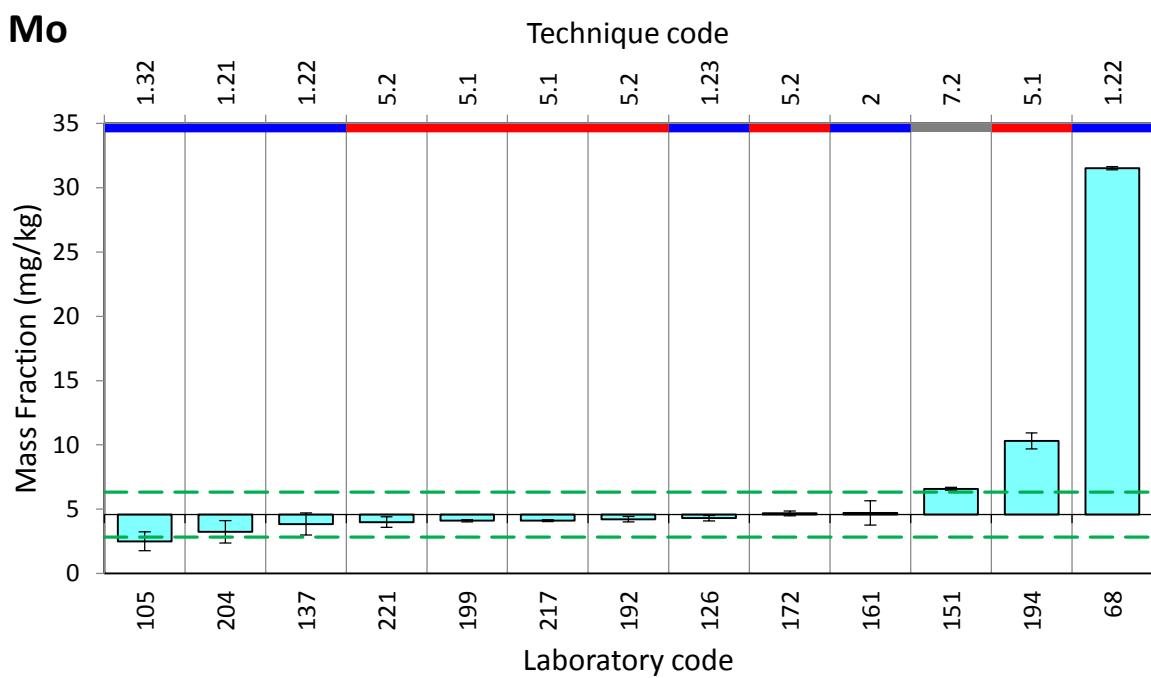


FIG. 70. Bar chart distributions of results for measurand Mg.



*FIG. 71. Bar chart distributions of results for measurand Mn.*



*FIG. 72. Bar chart distributions of results for measurand Mo.*

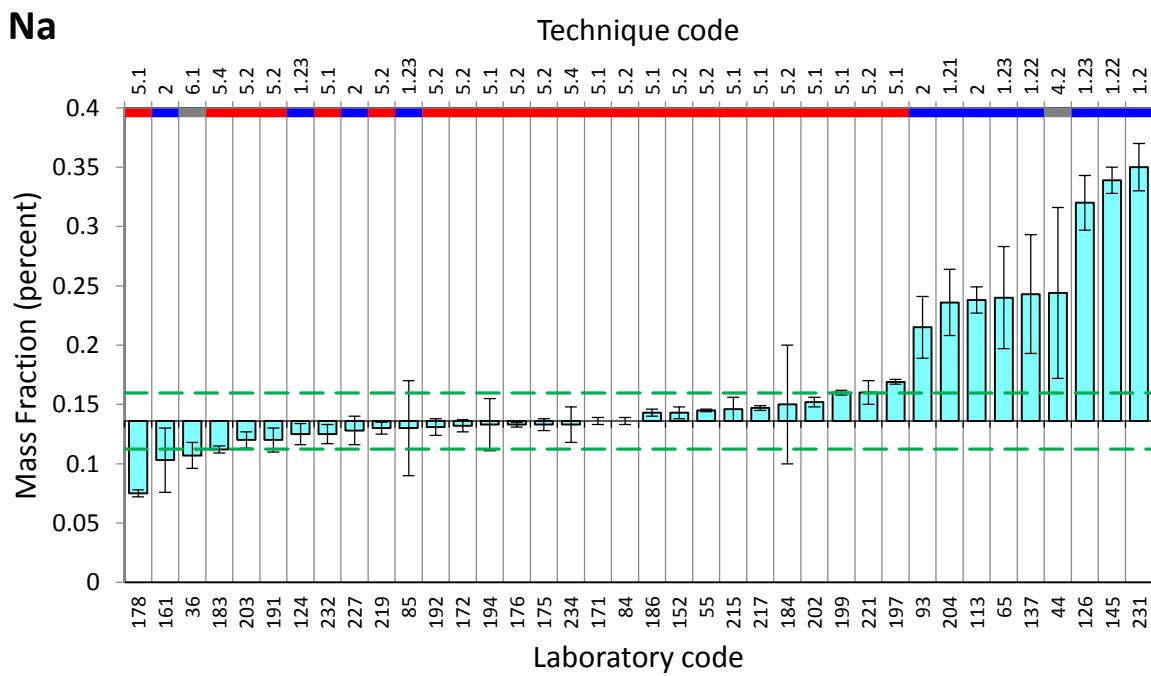


FIG. 73. Bar chart distributions of results for measurand Na.

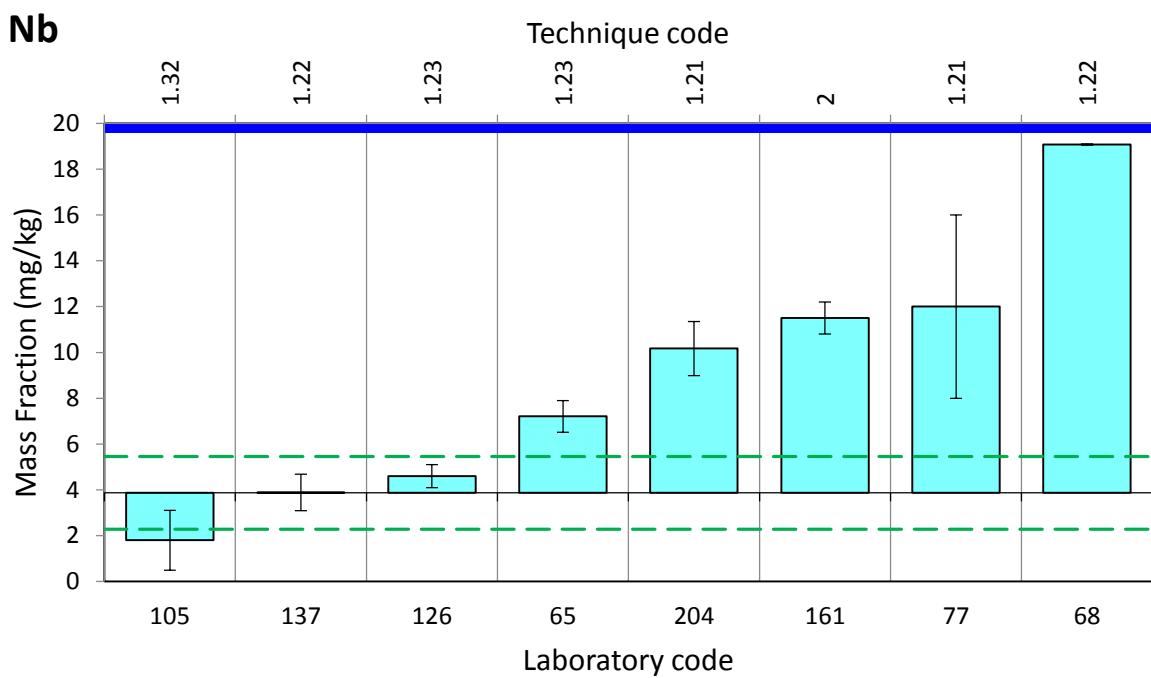


FIG. 74. Bar chart distributions of results for measurand Nb.

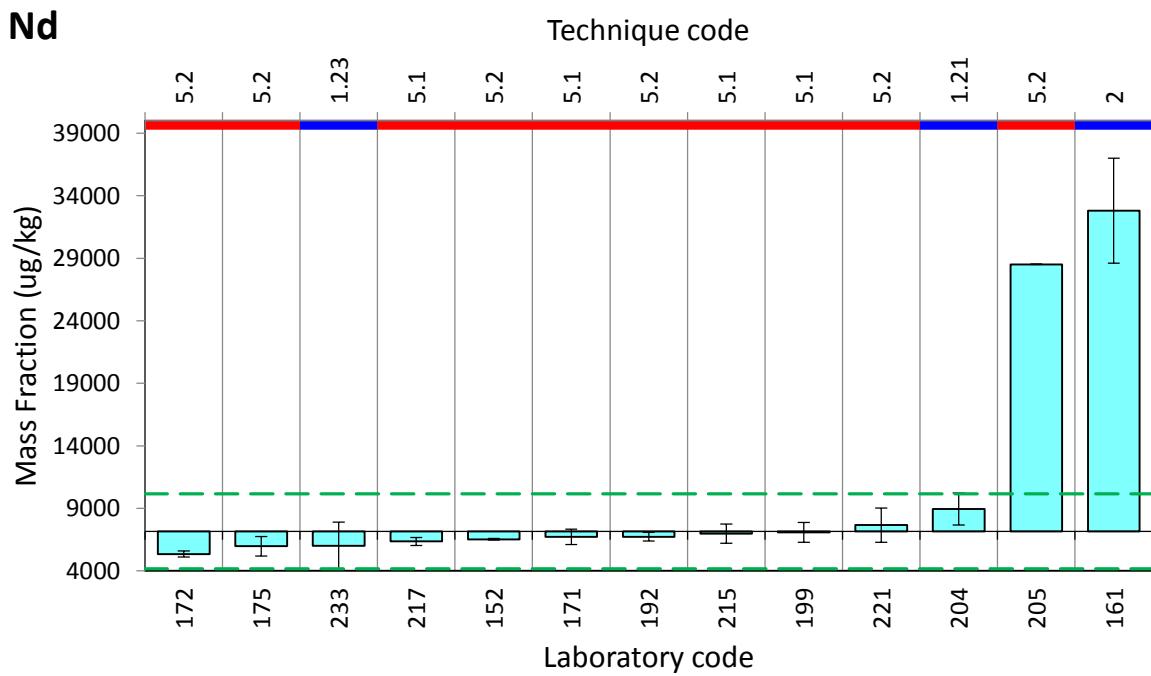


FIG. 75. Bar chart distributions of results for measurand Nd.

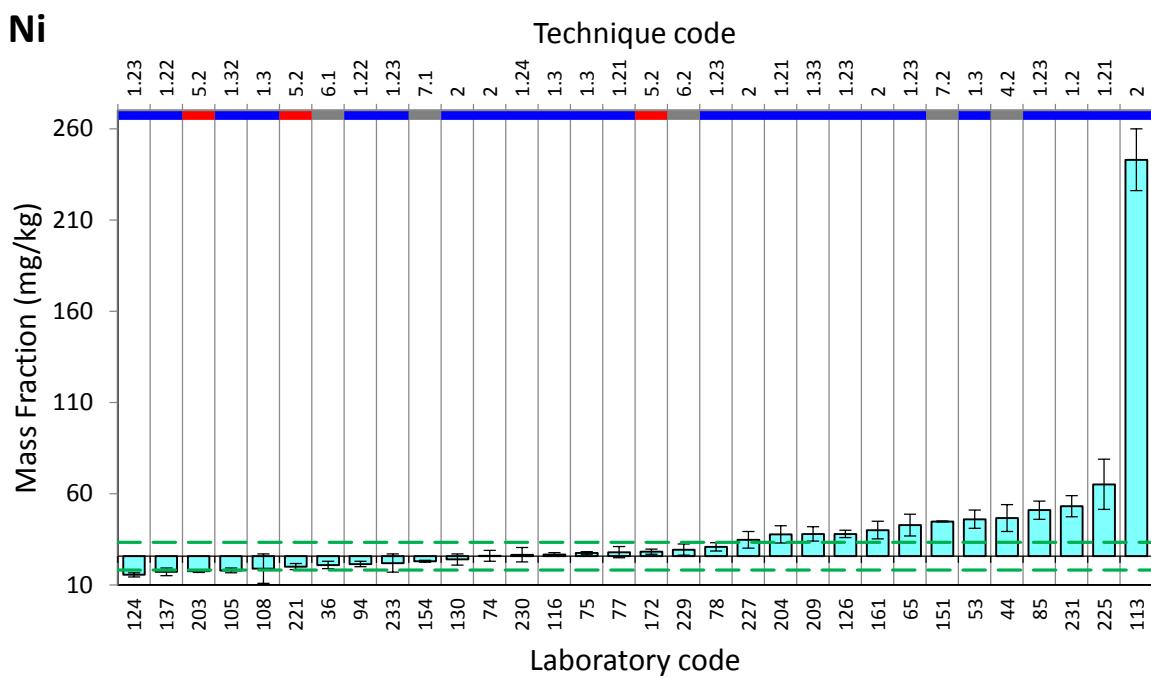


FIG. 76. Bar chart distributions of results for measurand Ni.

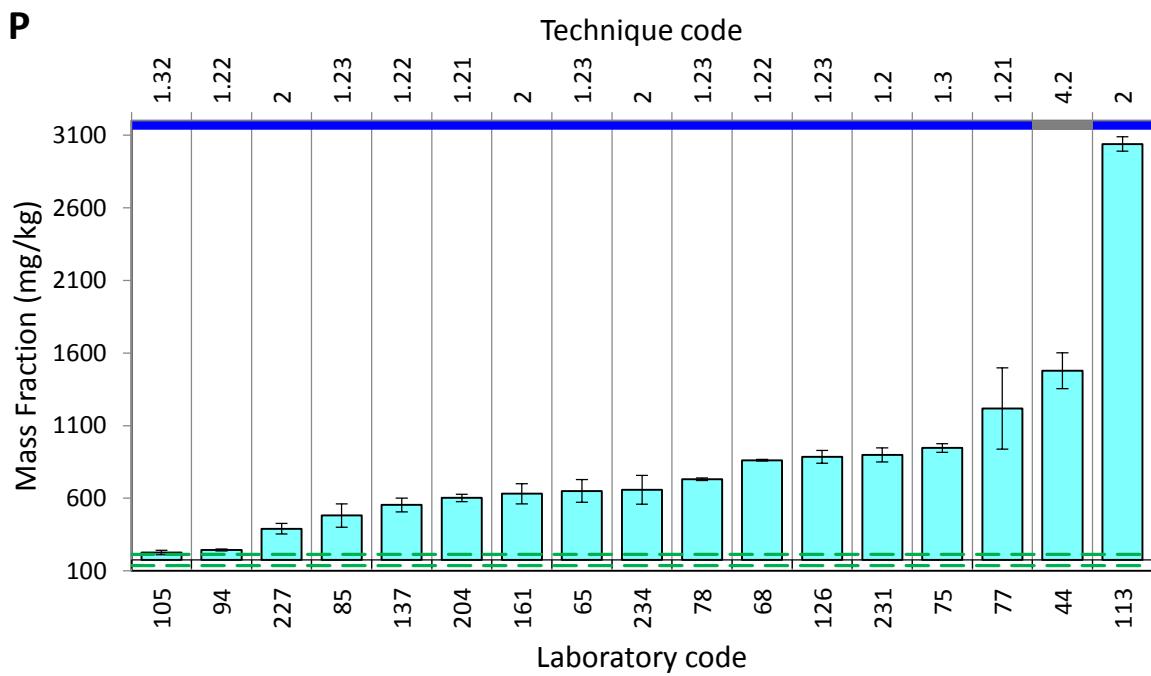


FIG. 77. Bar chart distributions of results for measurand P.

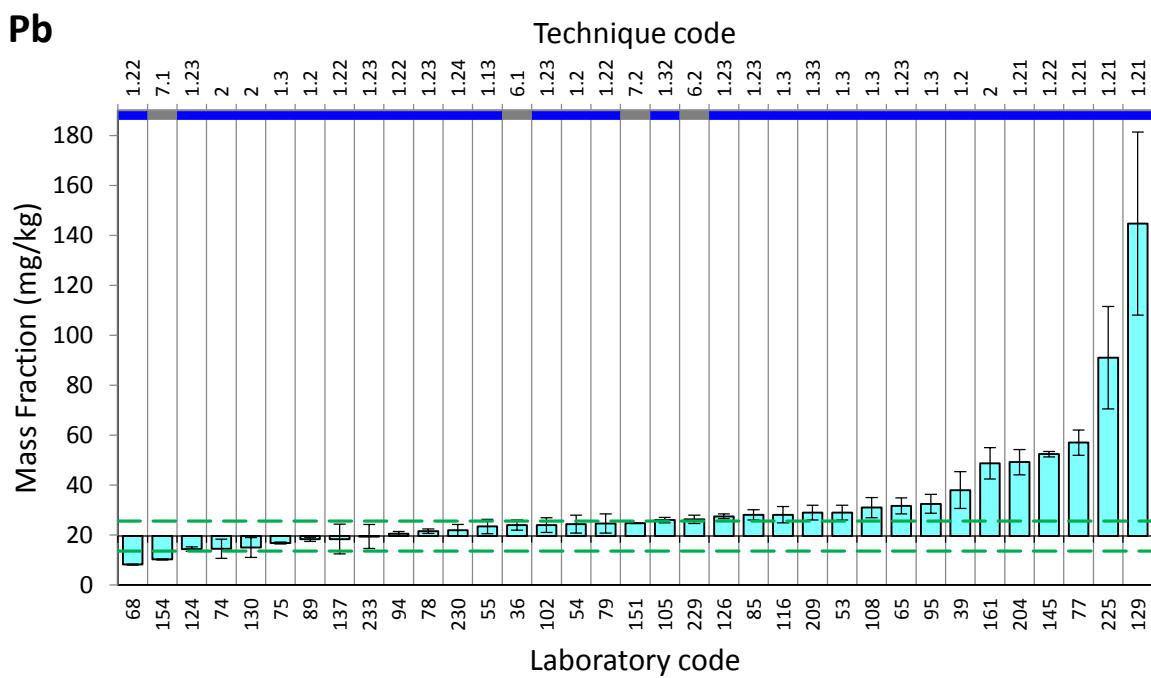


FIG. 78. Bar chart distributions of results for measurand Pb.

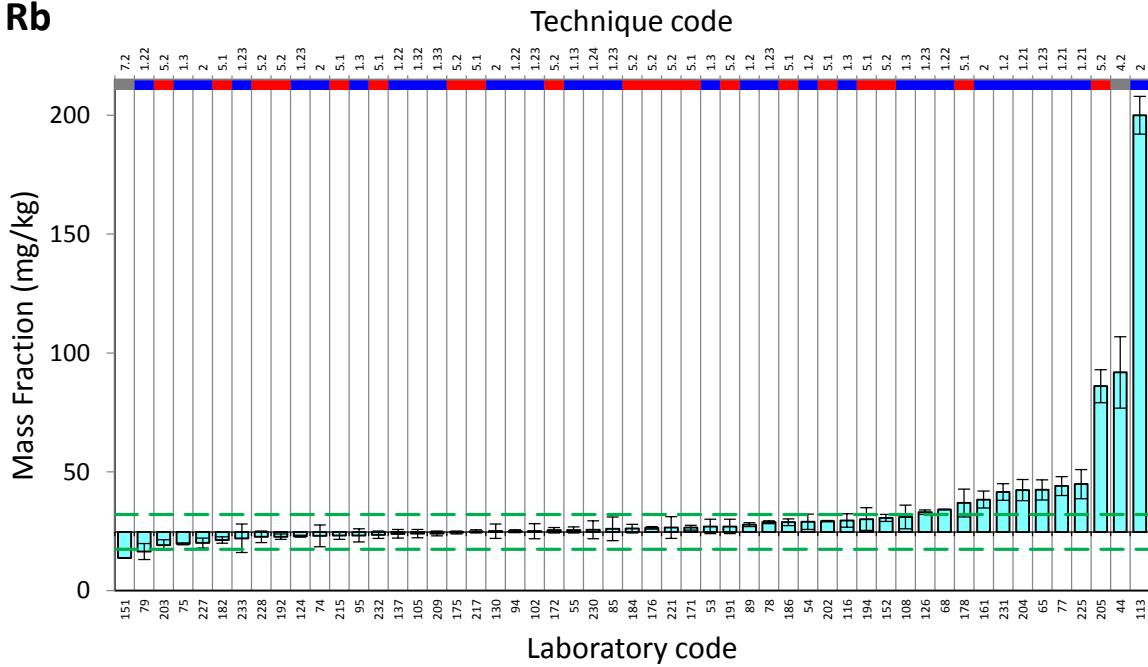
**Rb**

FIG. 79. Bar chart distributions of results for measurand Rb.

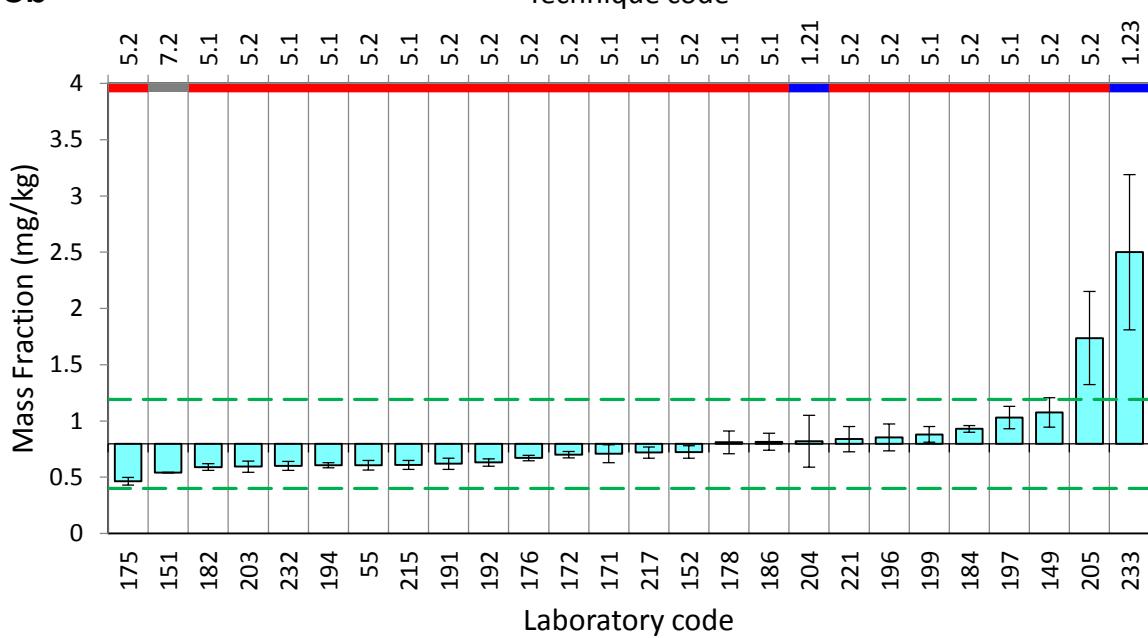
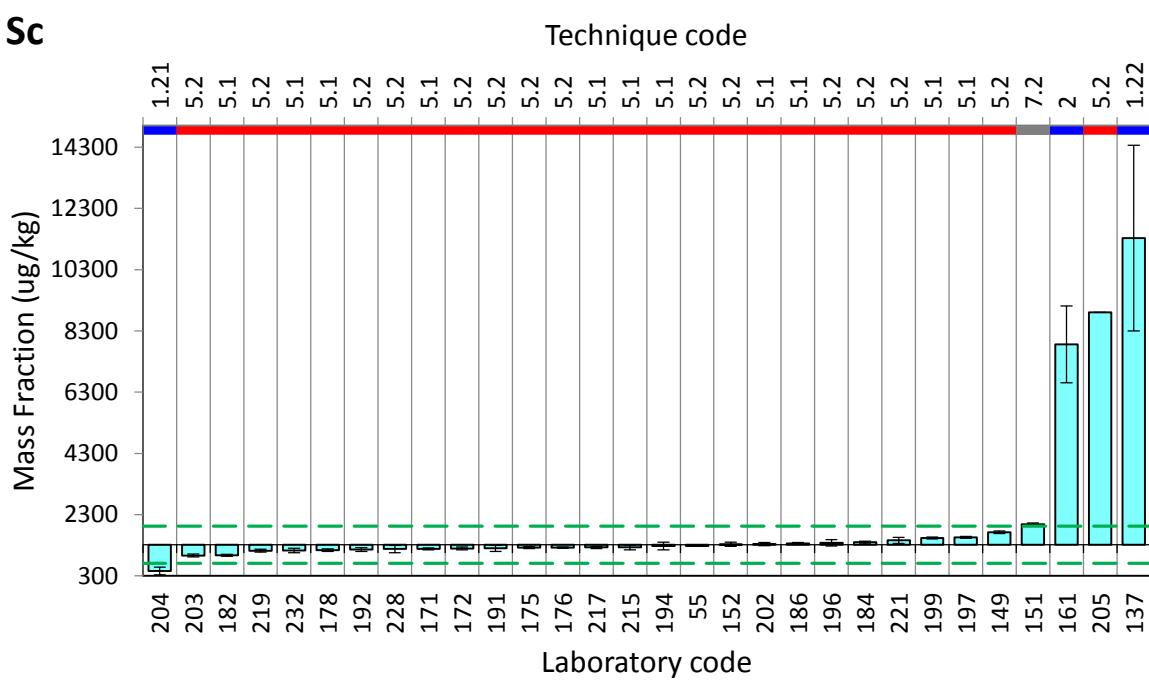
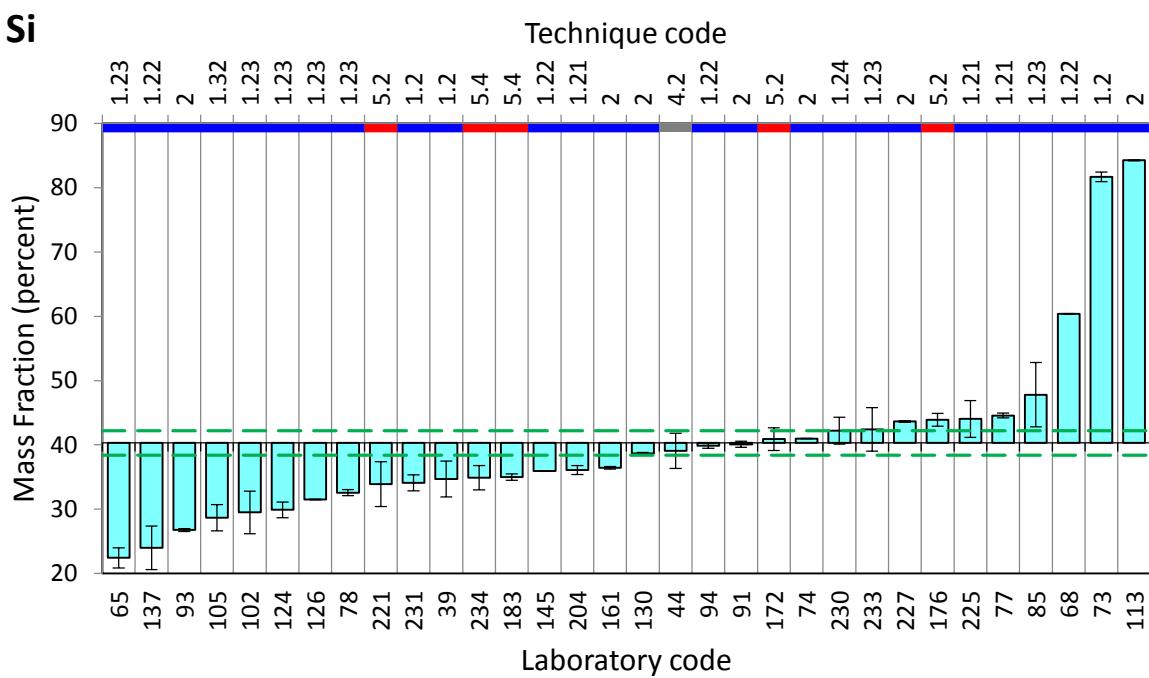
**Sb**

FIG. 80. Bar chart distributions of results for measurand Sb.



*FIG. 81. Bar chart distributions of results for measurand Sc.*



*FIG. 82. Bar chart distributions of results for measurand Si.*

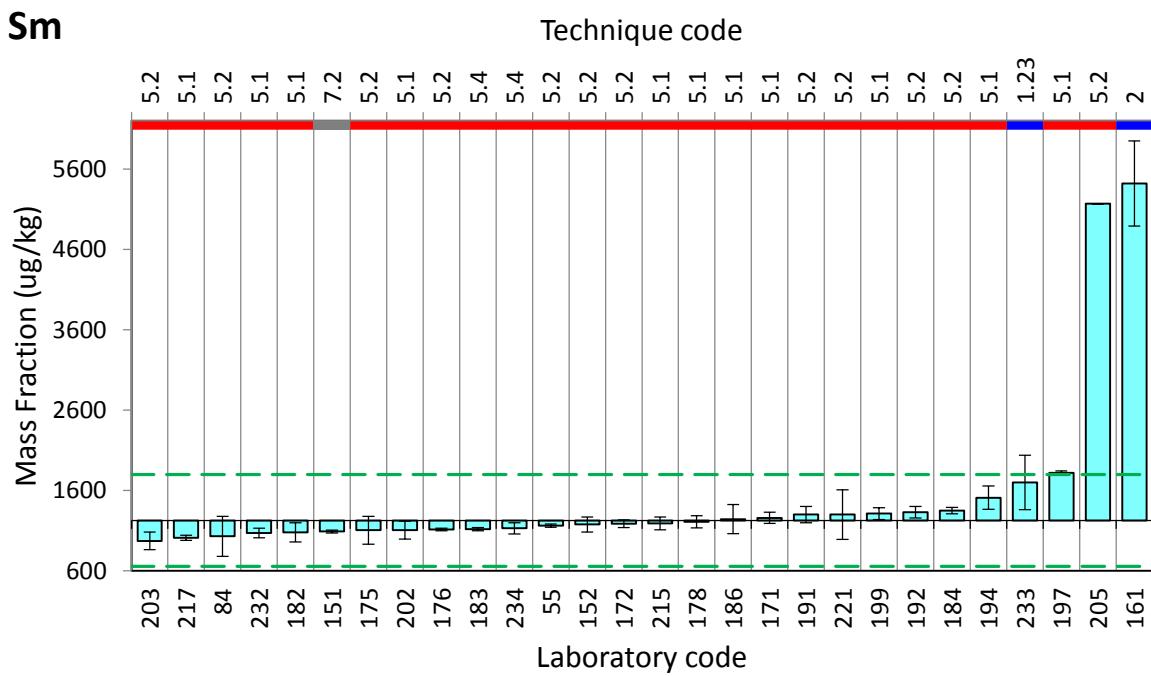


FIG. 83. Bar chart distributions of results for measurand Sm.

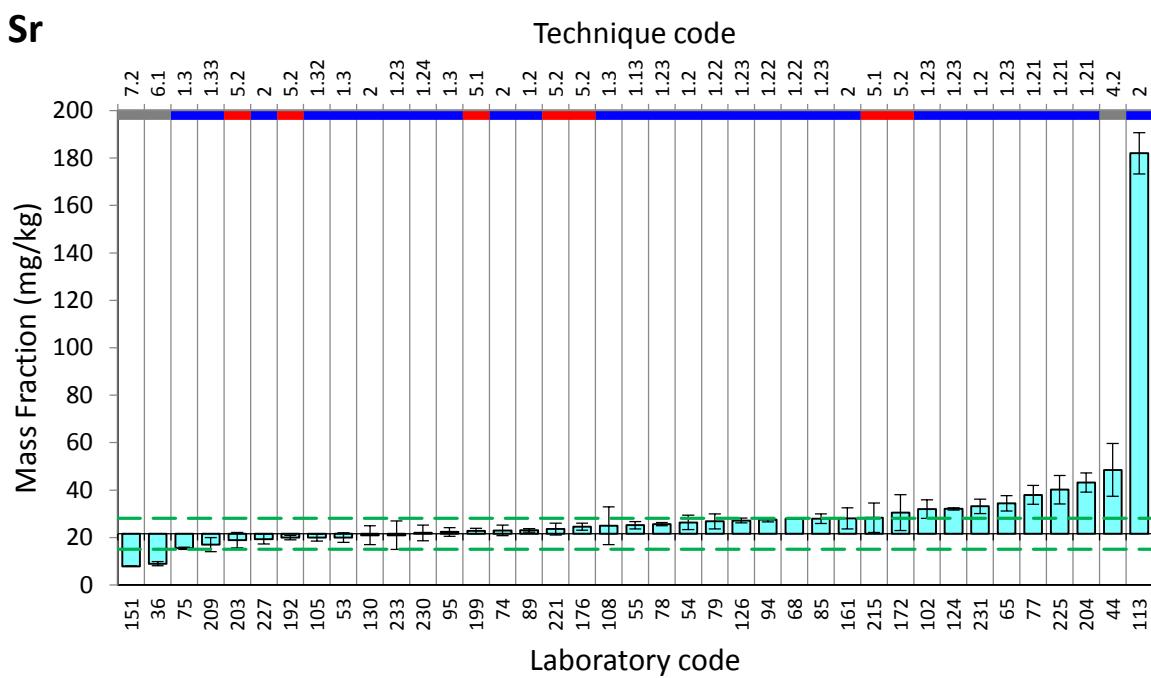


FIG. 84. Bar chart distributions of results for measurand Sr.

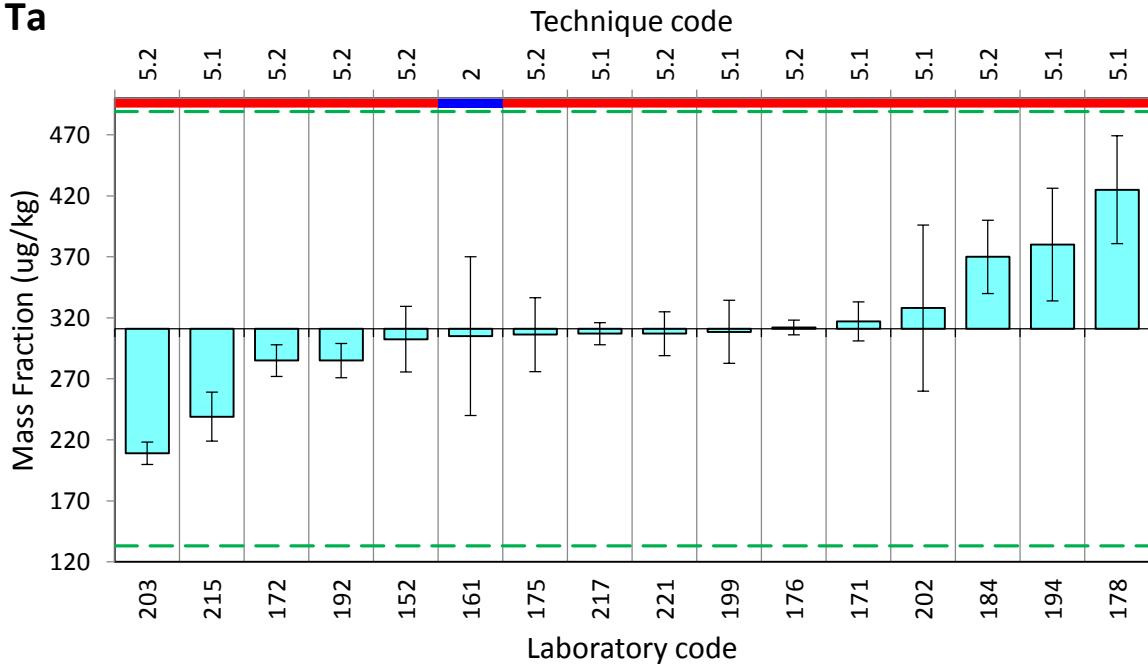
**Ta**

FIG. 85. Bar chart distributions of results for measurand Ta.

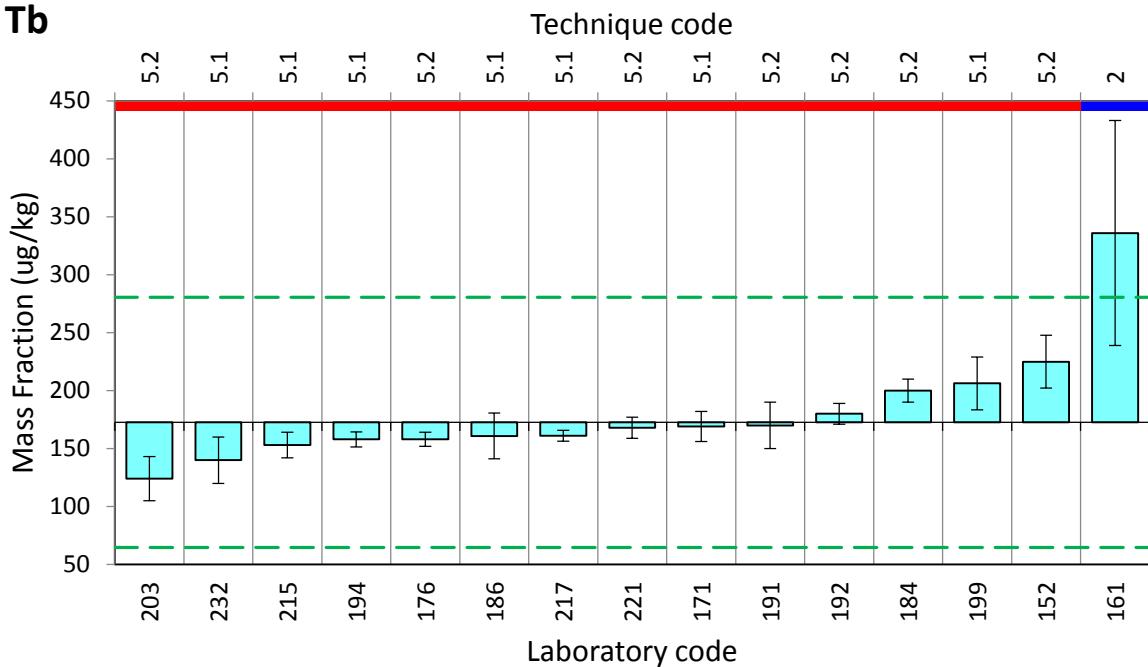
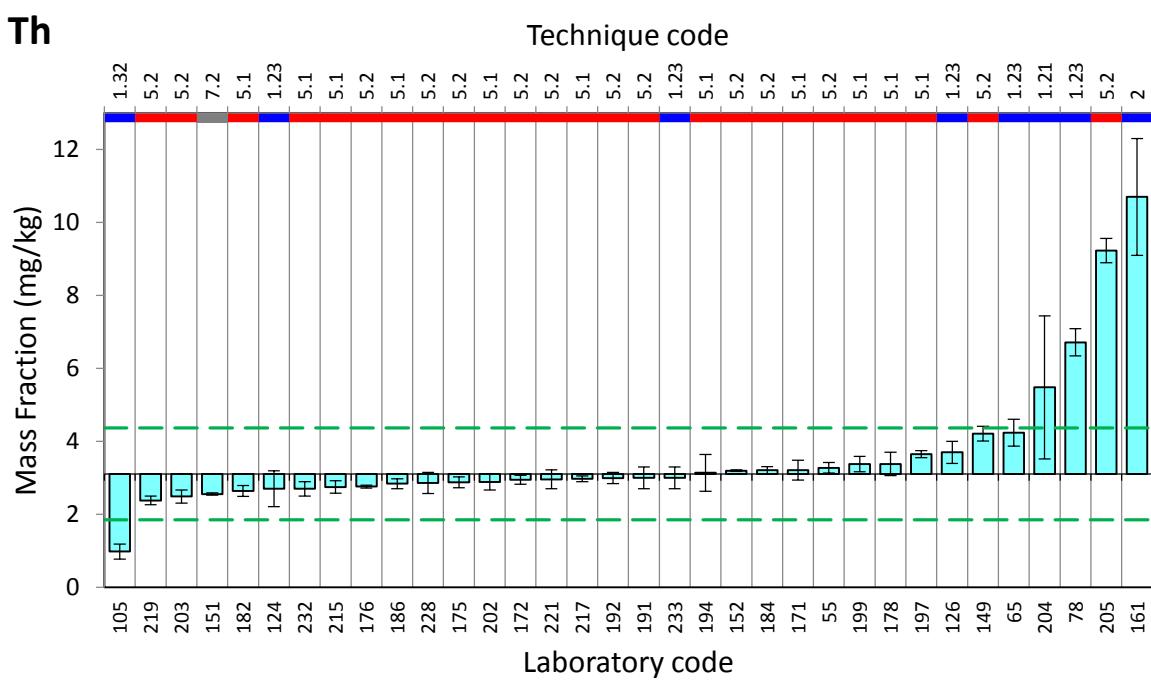
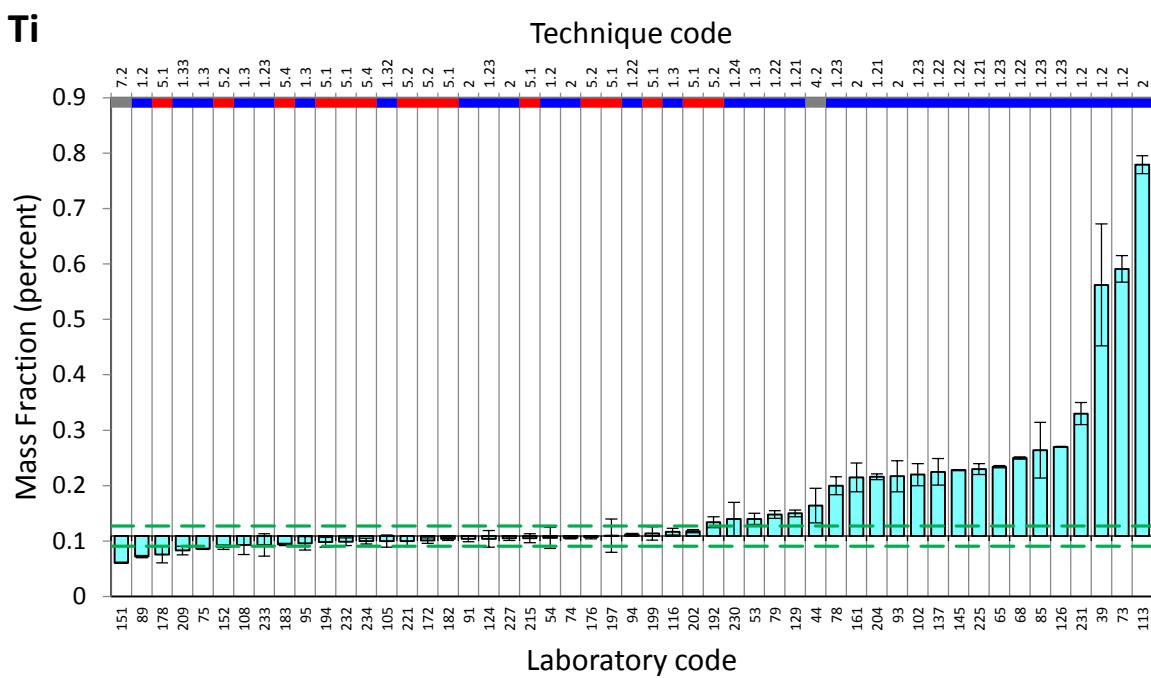
**Tb**

FIG. 86. Bar chart distributions of results for measurand Tb.



*FIG. 87. Bar chart distributions of results for measurand Th.*



*FIG. 88. Bar chart distributions of results for measurand Ti.*

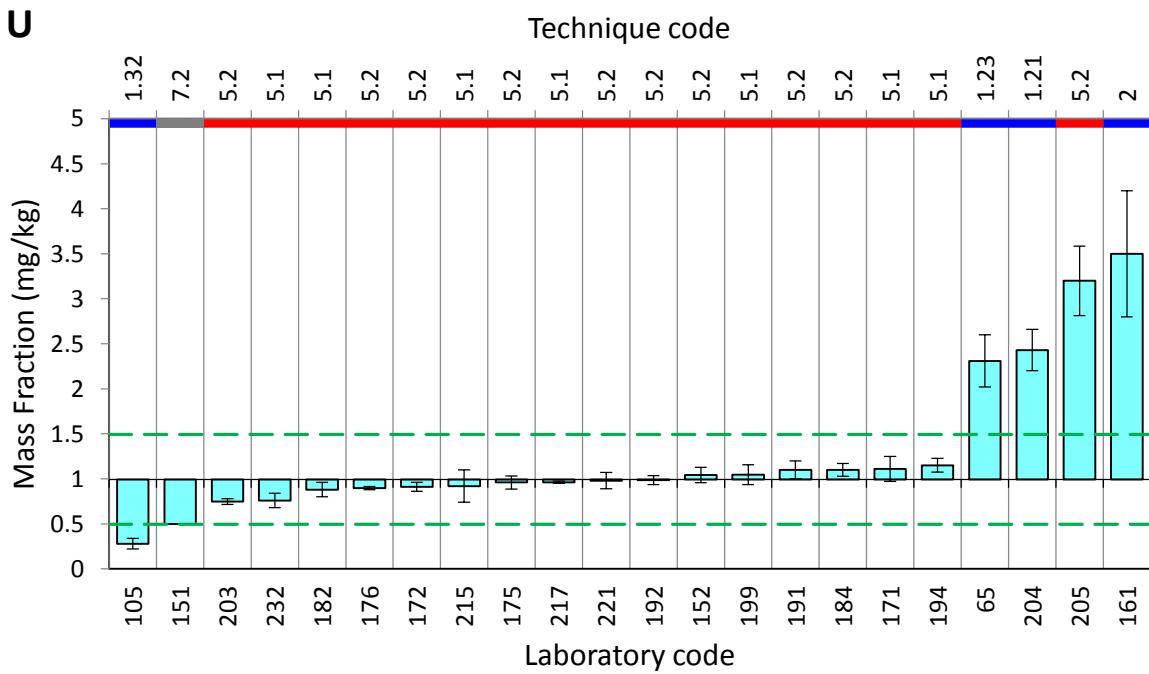


FIG. 89. Bar chart distributions of results for measurand U.

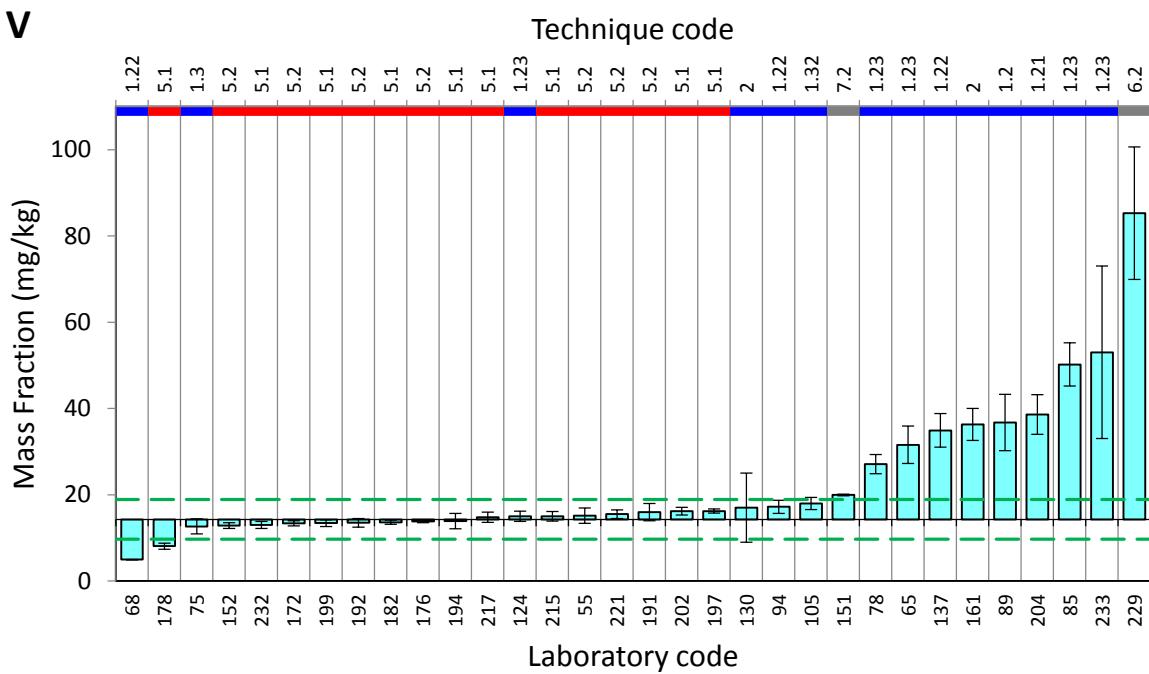


FIG. 90. Bar chart distributions of results for measurand V.

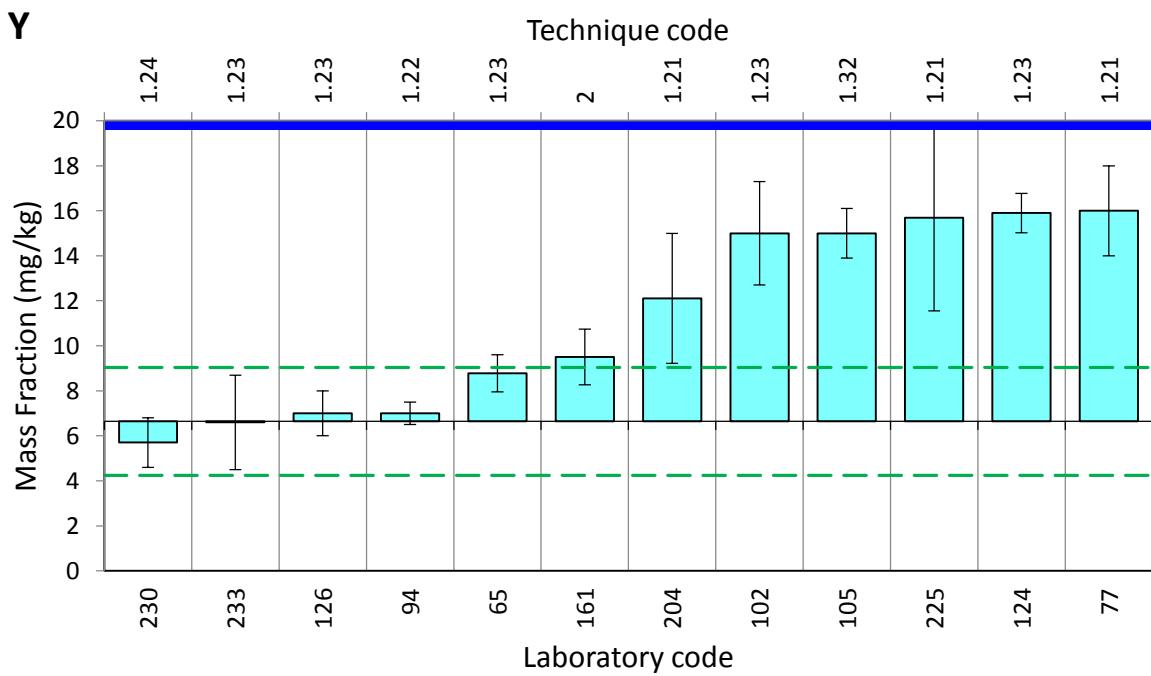


FIG. 91. Bar chart distributions of results for measurand Y.

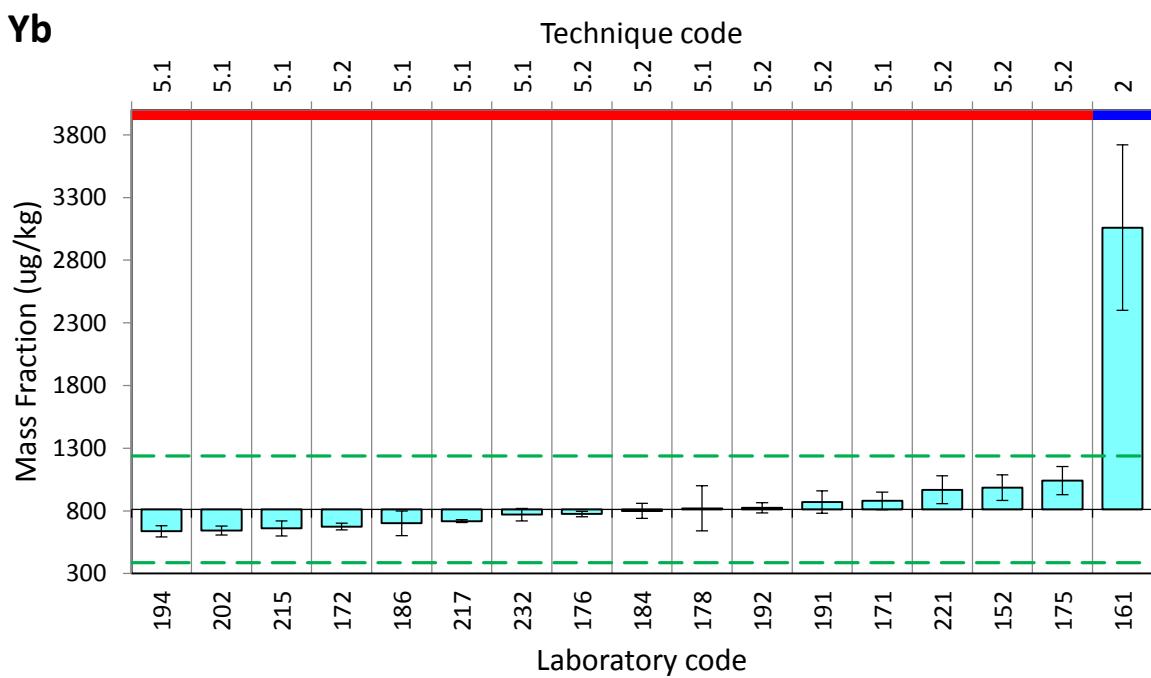
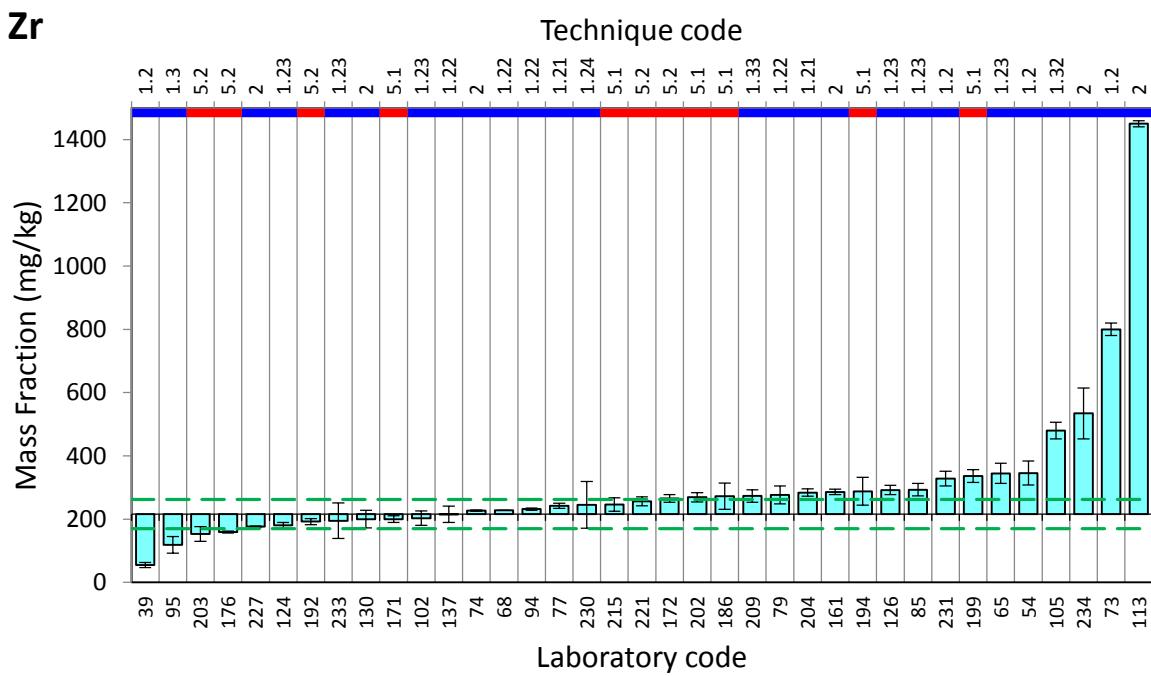


FIG. 92. Bar chart distributions of results for measurand Yb.



*FIG. 93. Bar chart distributions of results for measurand Zr.*

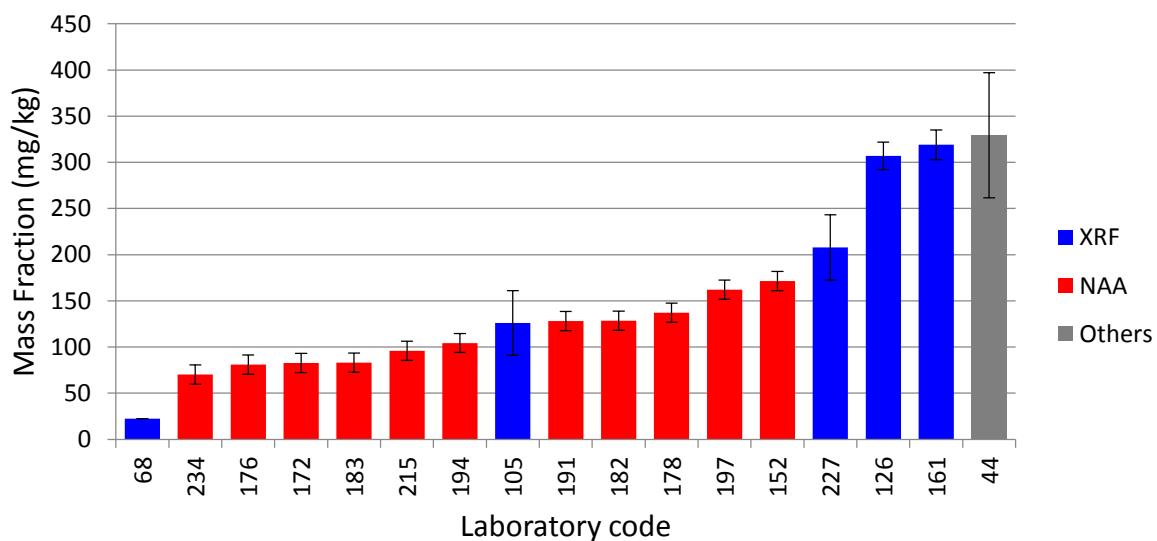
**C**

FIG. 94. Bar chart distributions of results for measurand Cl.

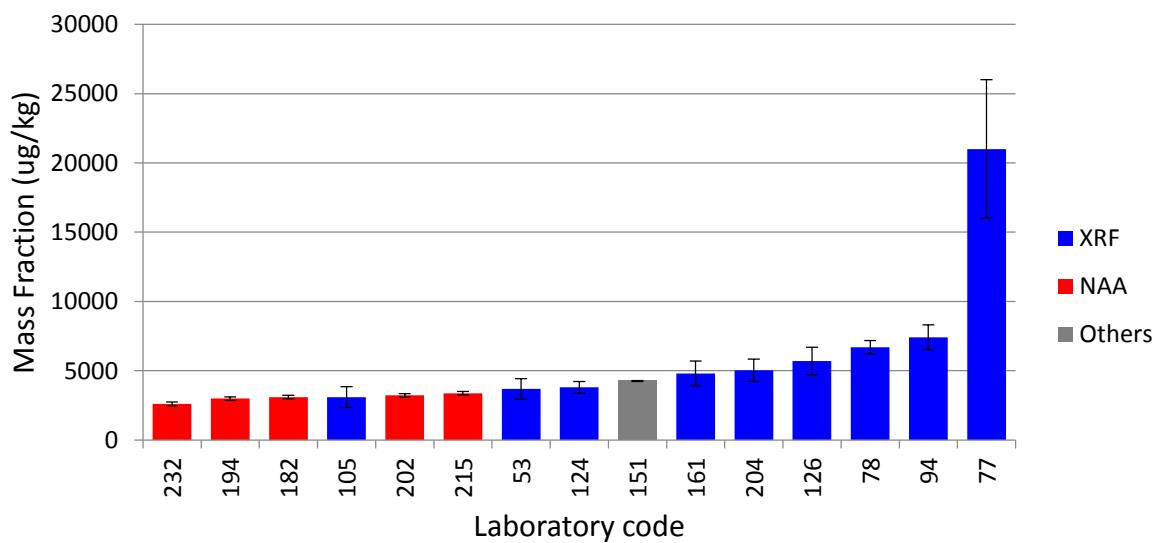
**Ga**

FIG. 95. Bar chart distributions of results for measurand Ga.

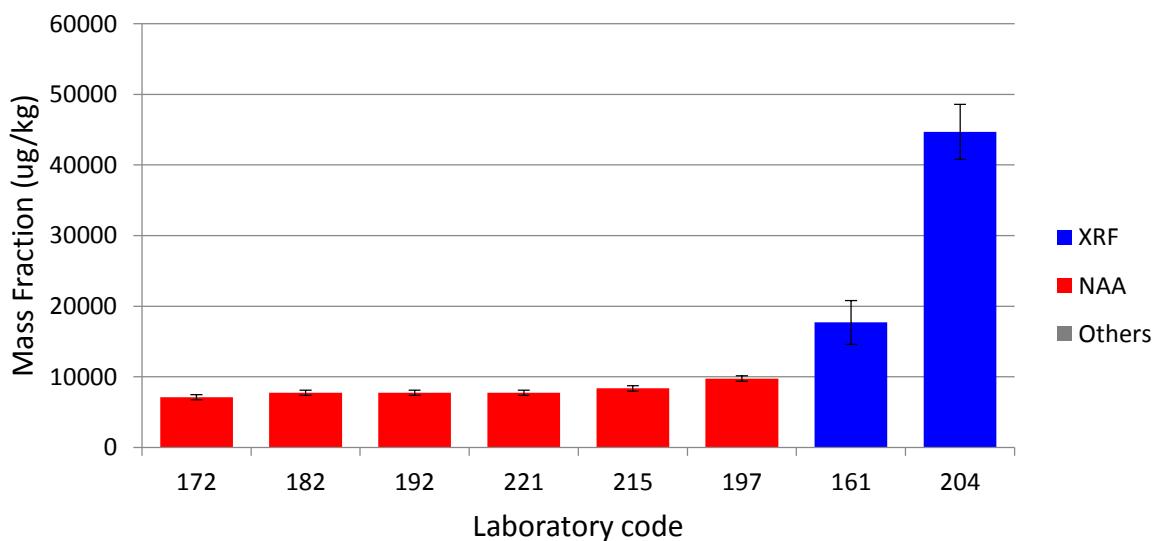
**I**

FIG. 96. Bar chart distributions of results for measurand I.

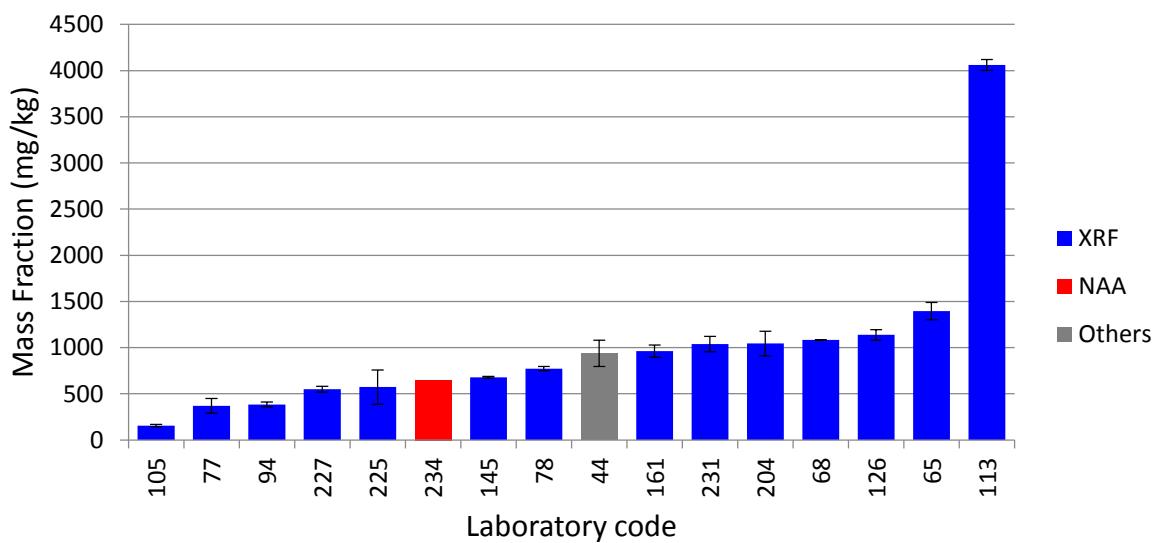
**S**

FIG. 97. Bar chart distributions of results for measurand S.

## Se

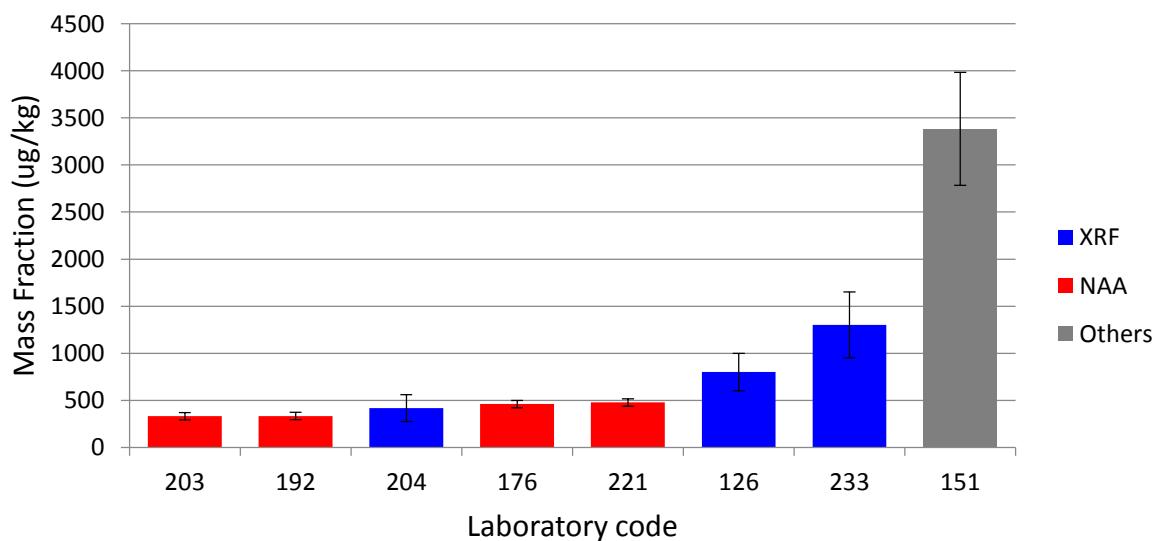


FIG. 98. Bar chart distributions of results for measurand Se.

## Zn

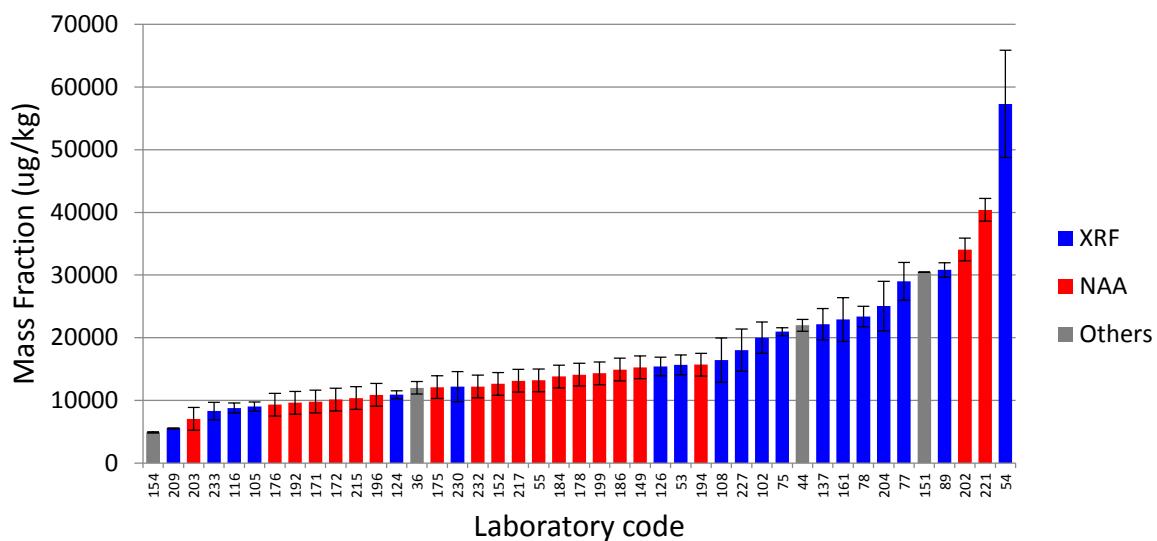


FIG. 99. Bar chart distributions of results for measurand Zn.

36

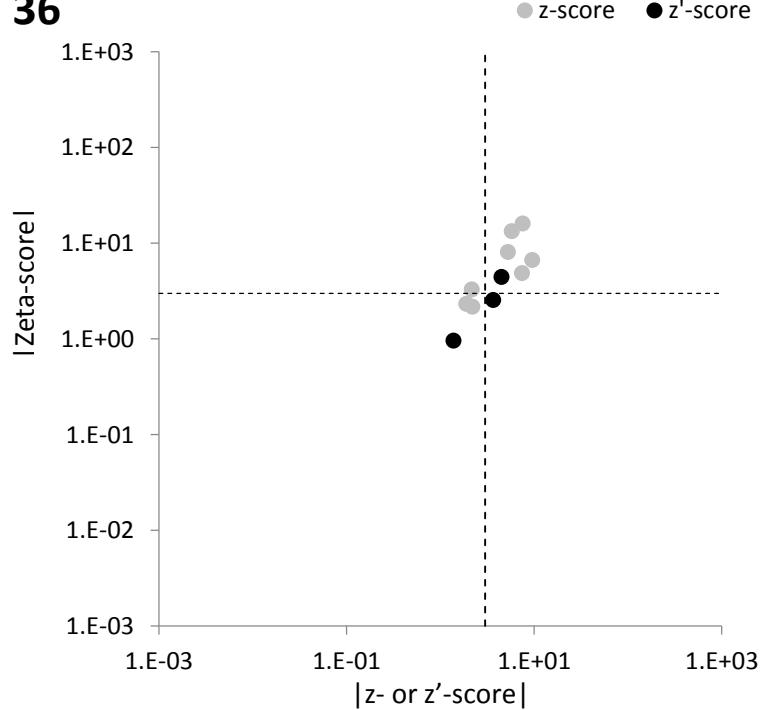


FIG. 100. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 36.

39

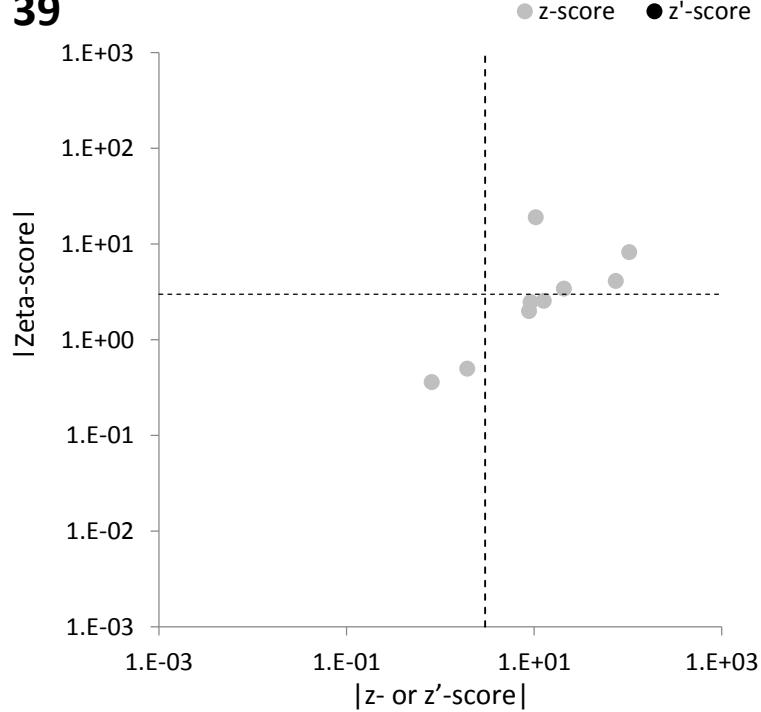


FIG. 101. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 39.

44

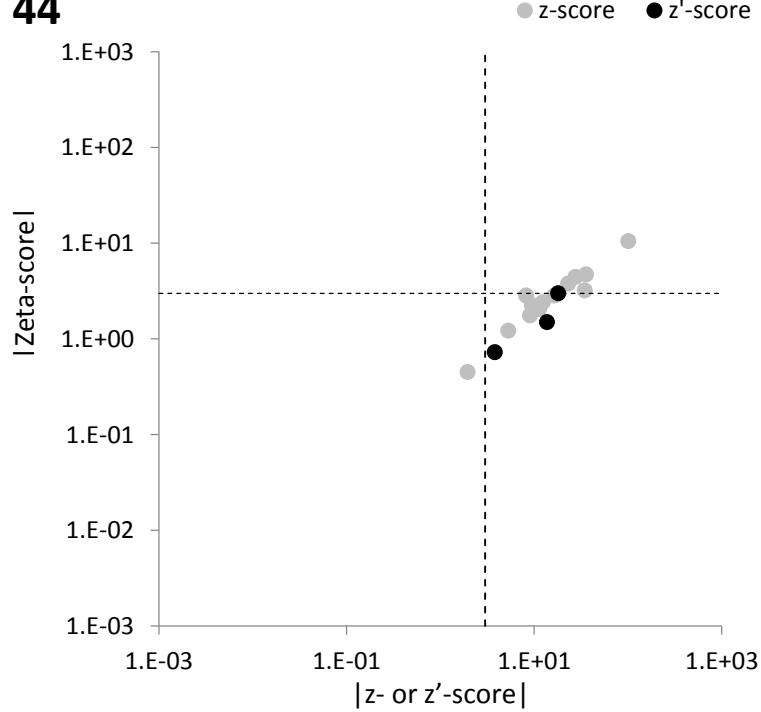


FIG. 102. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 44.

53

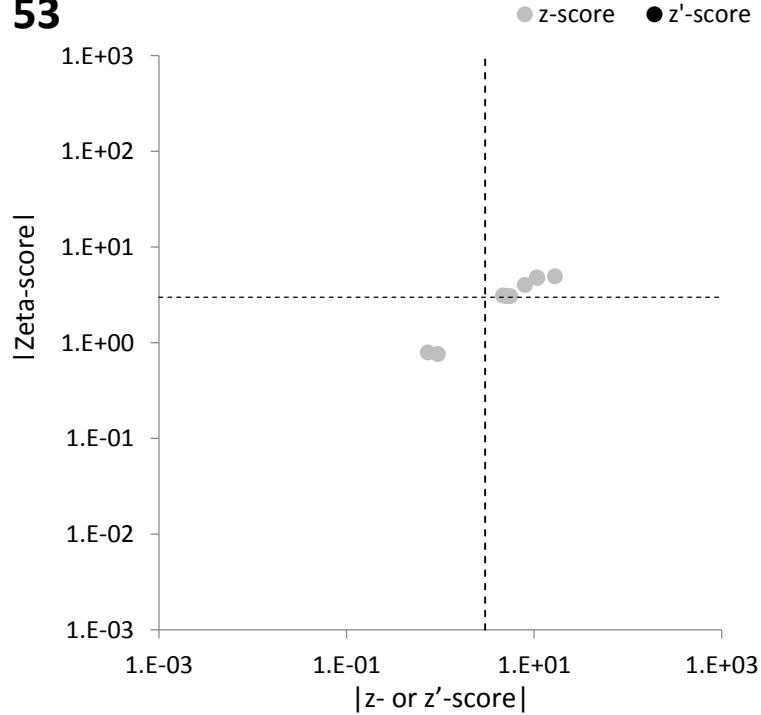


FIG. 103. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 53.

**54**

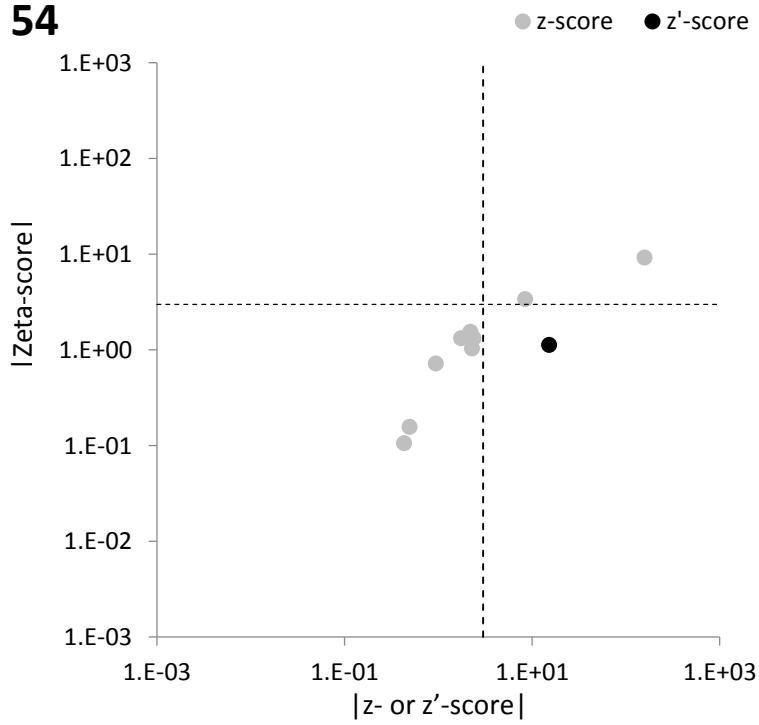


FIG. 104. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 54.

**55**

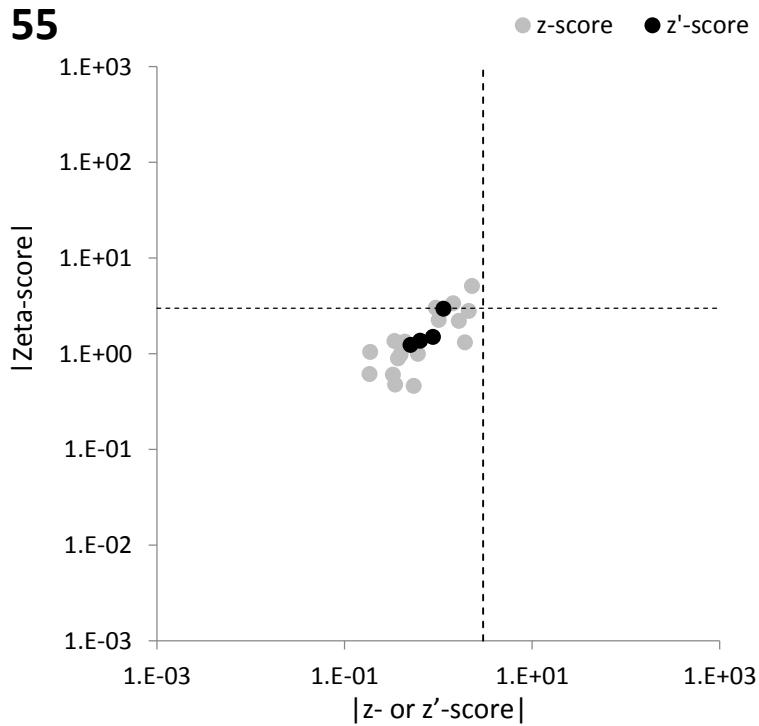
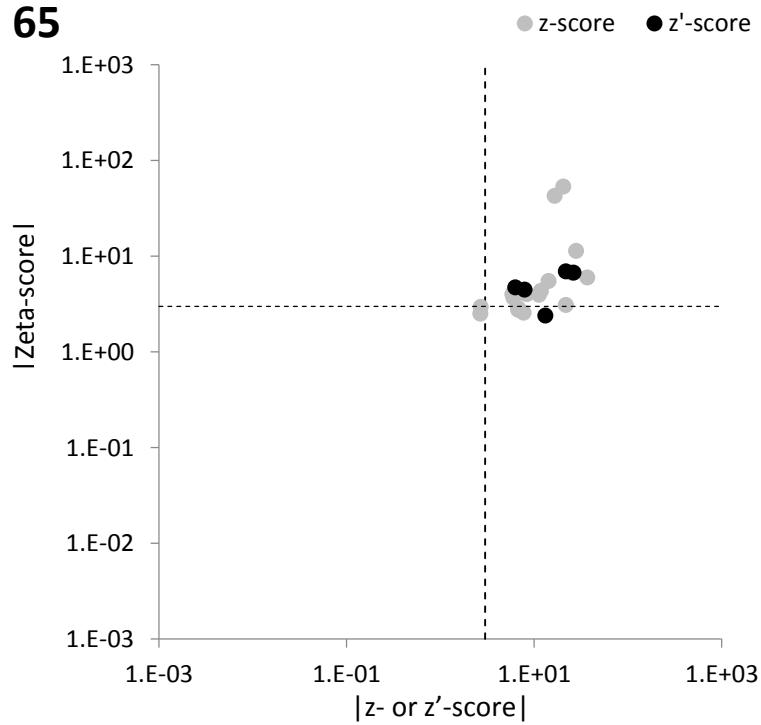


FIG. 105. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 55.

**65**



**73**

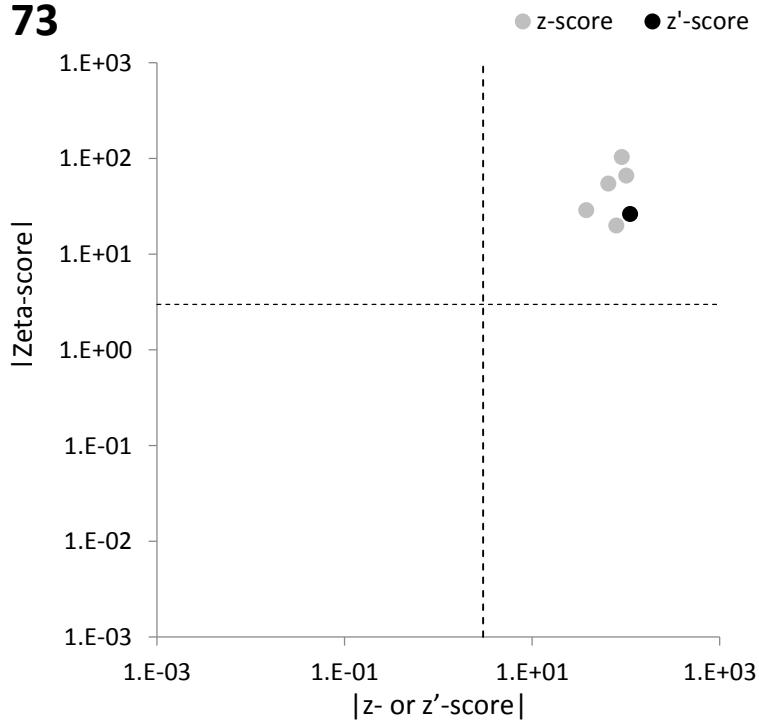


FIG. 108. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 73.

**74**

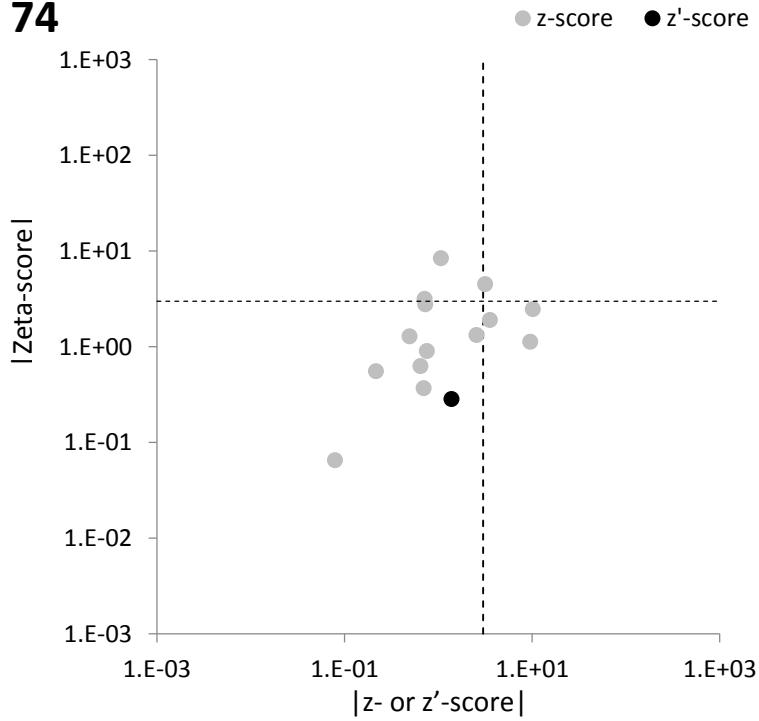


FIG. 109. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 74.

**75**

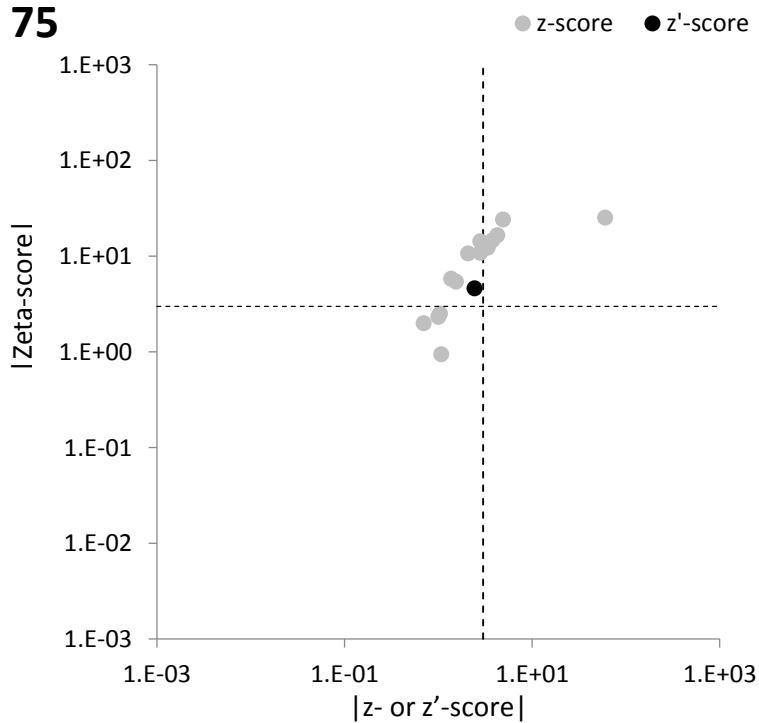


FIG. 110. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 75.

**77**

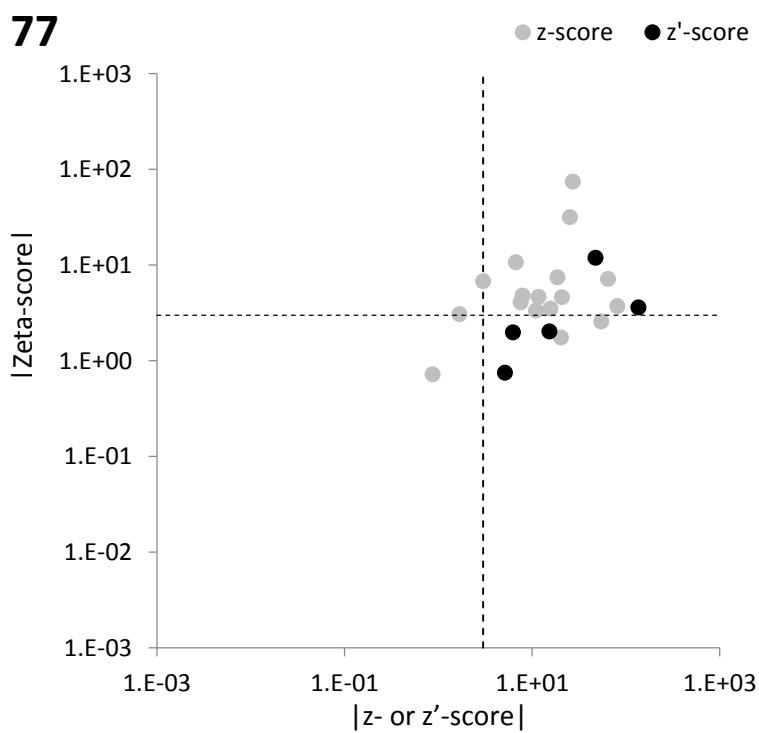


FIG. 111. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 77.

**78**

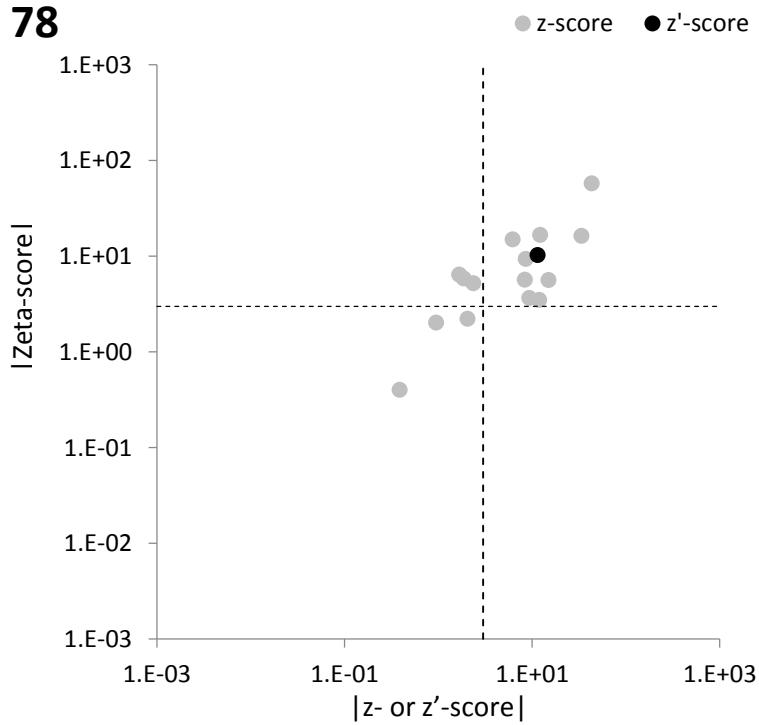


FIG. 112. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 78.

**79**

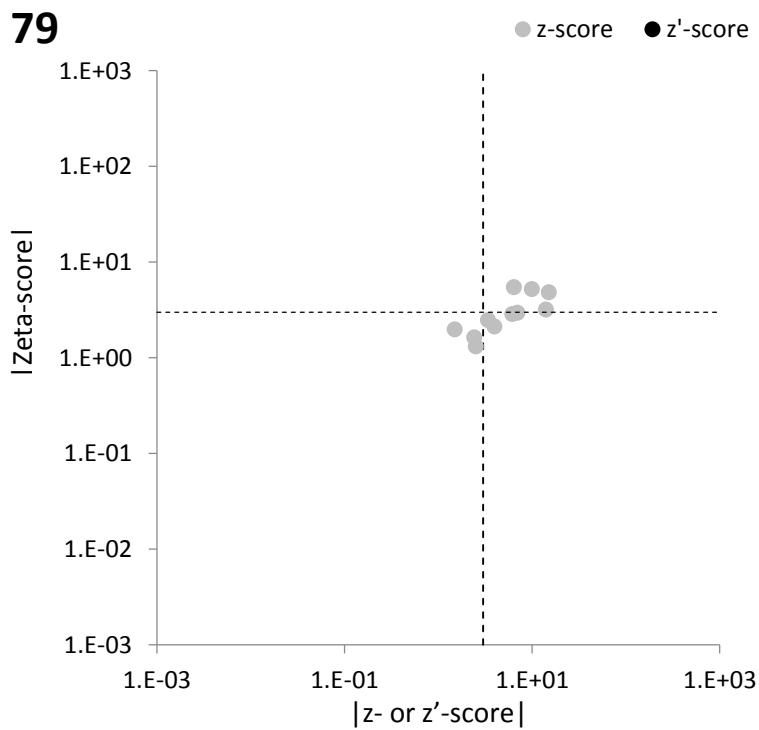


FIG. 113. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 79.

**84**

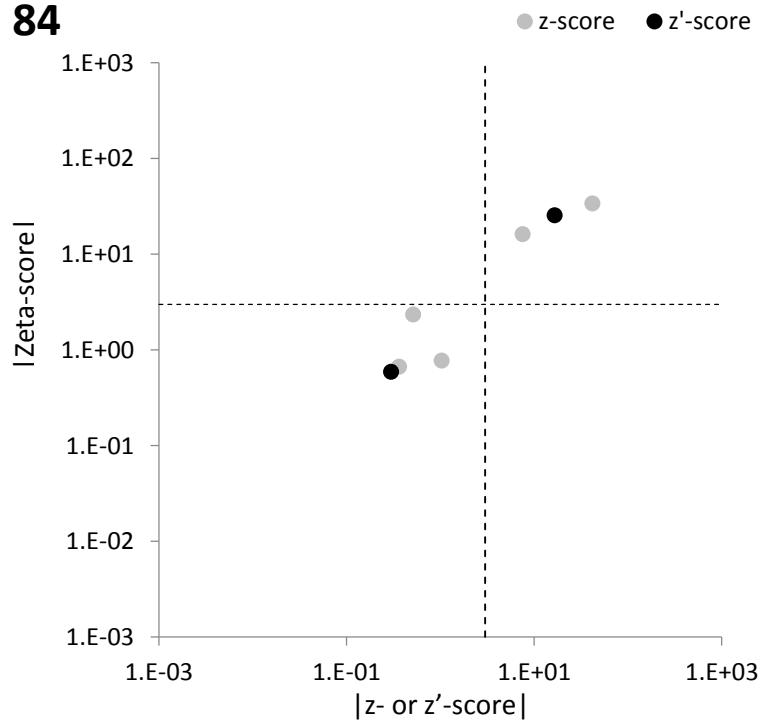


FIG. 114. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 84.

**85**

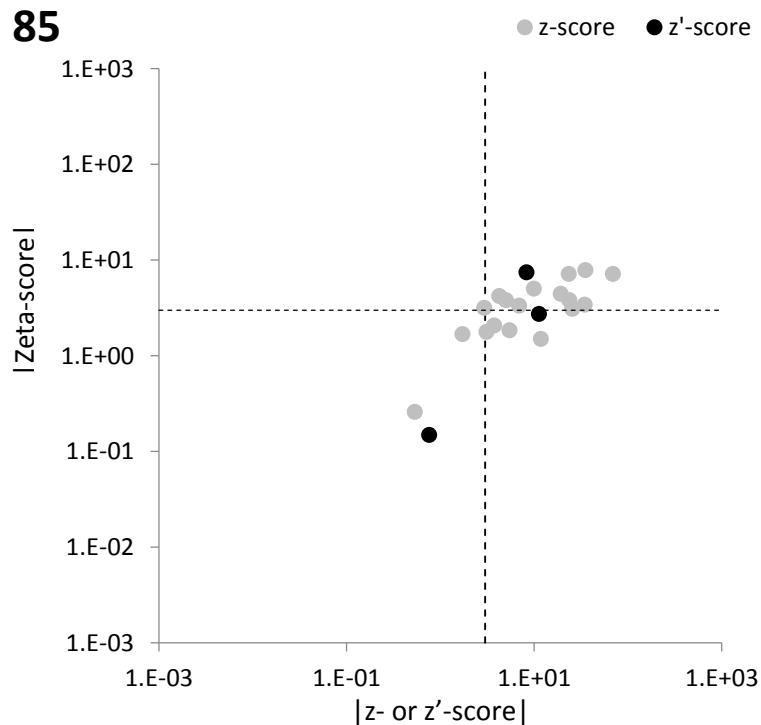


FIG. 115. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 85.

**89**

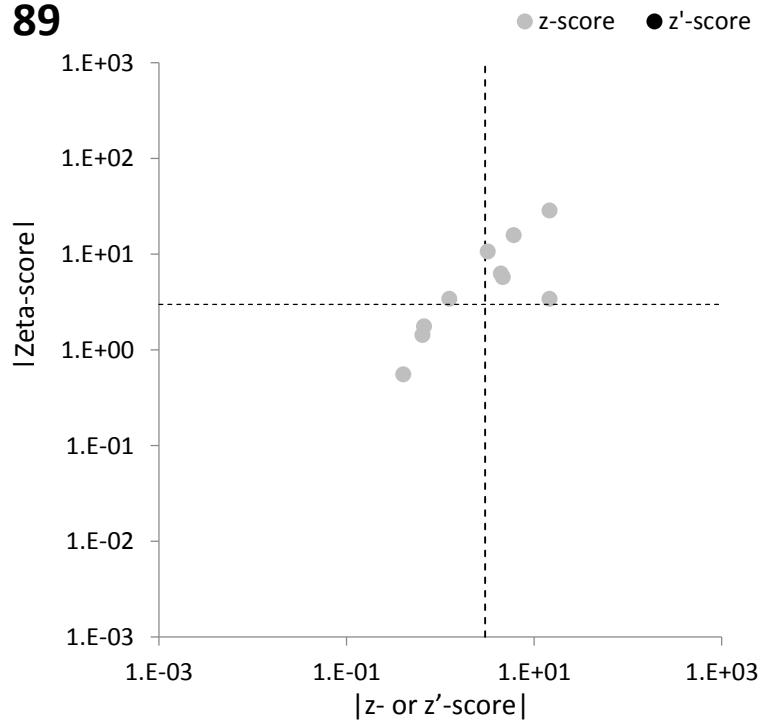


FIG. 116. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 89.

**91**

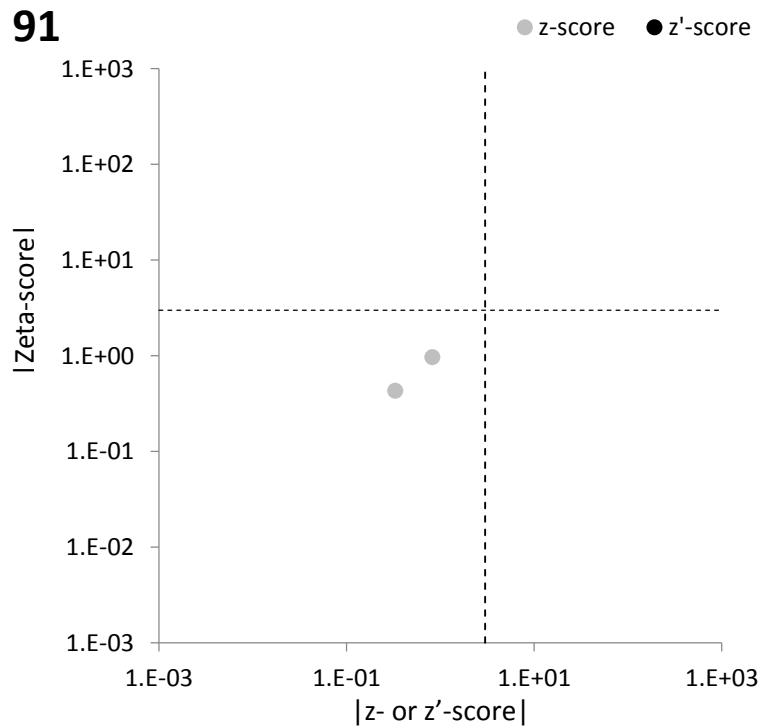


FIG. 117. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 91.

**93**

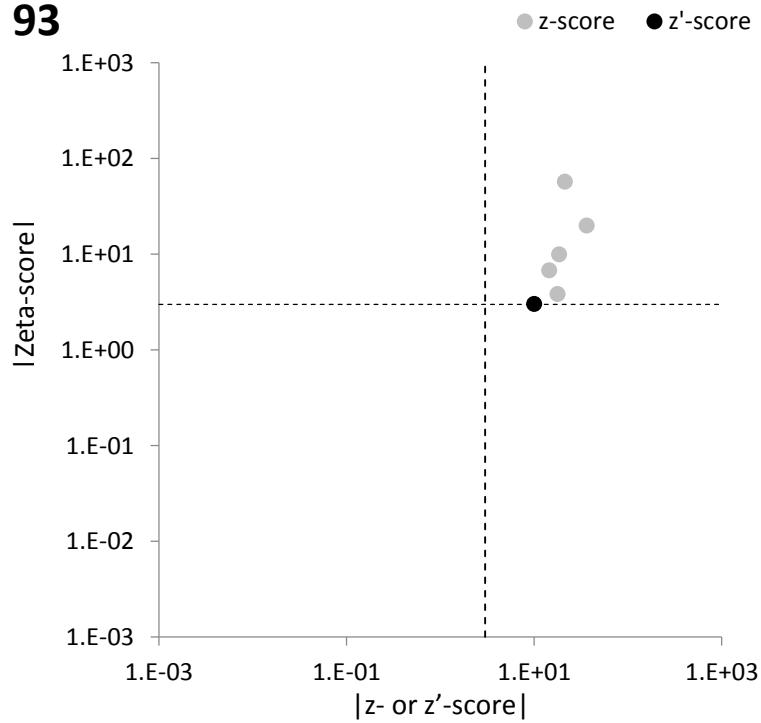


FIG. 118. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 93.

**94**

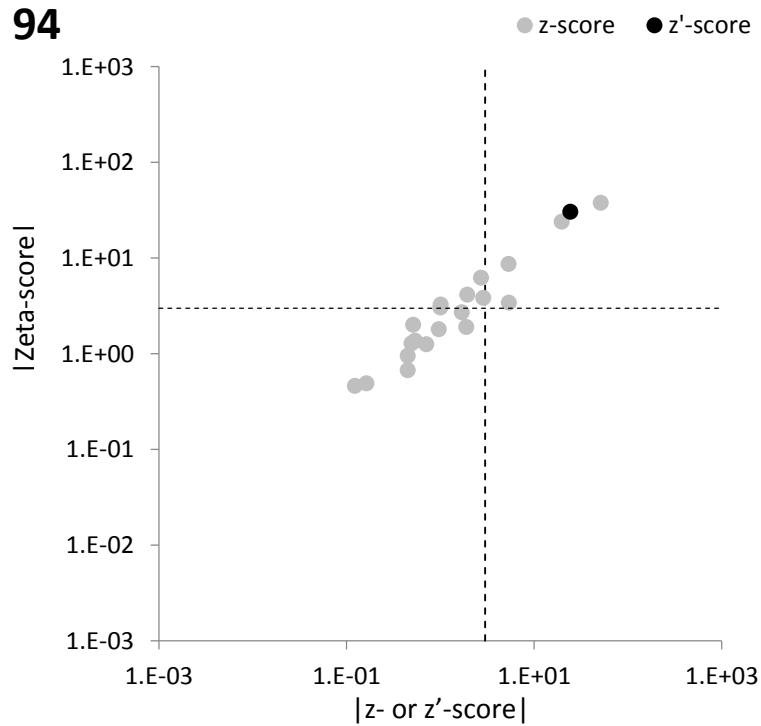


FIG. 119. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 94.

95

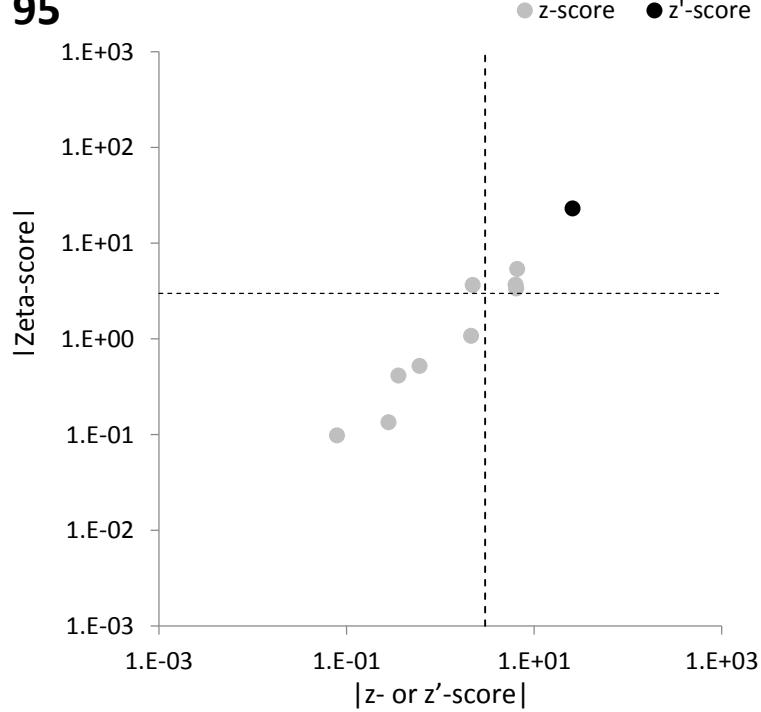


FIG. 120. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 95.

102

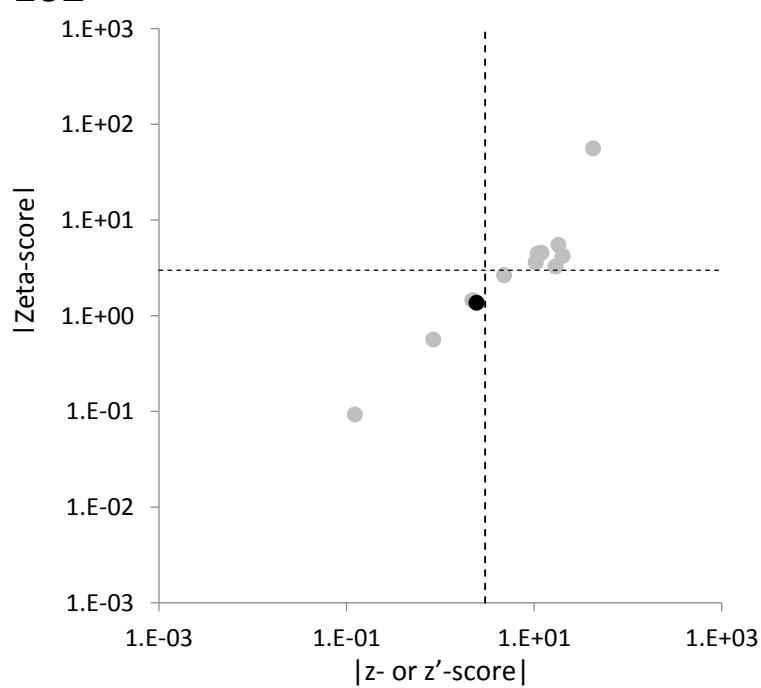


FIG. 121. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 102.

**105**

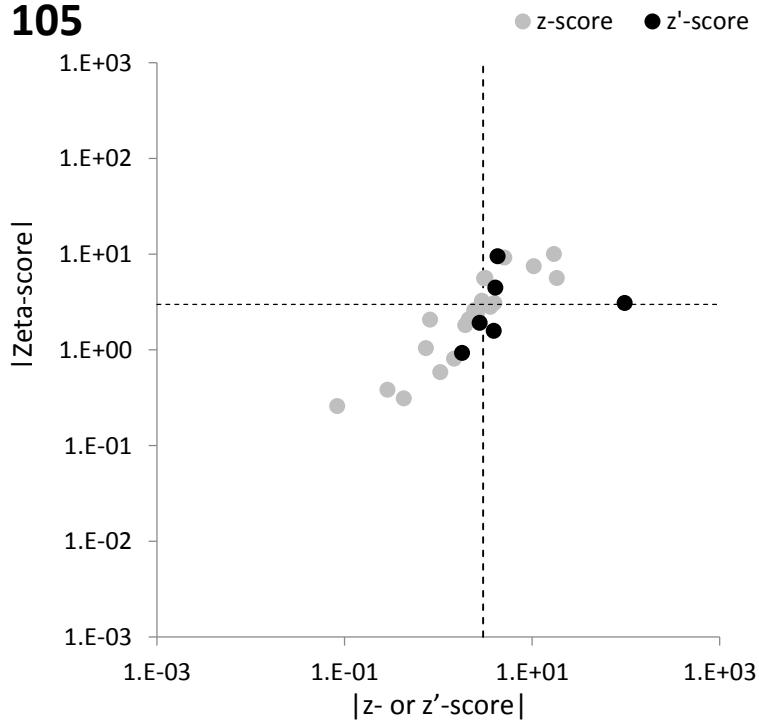


FIG. 122. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 105.

**108**

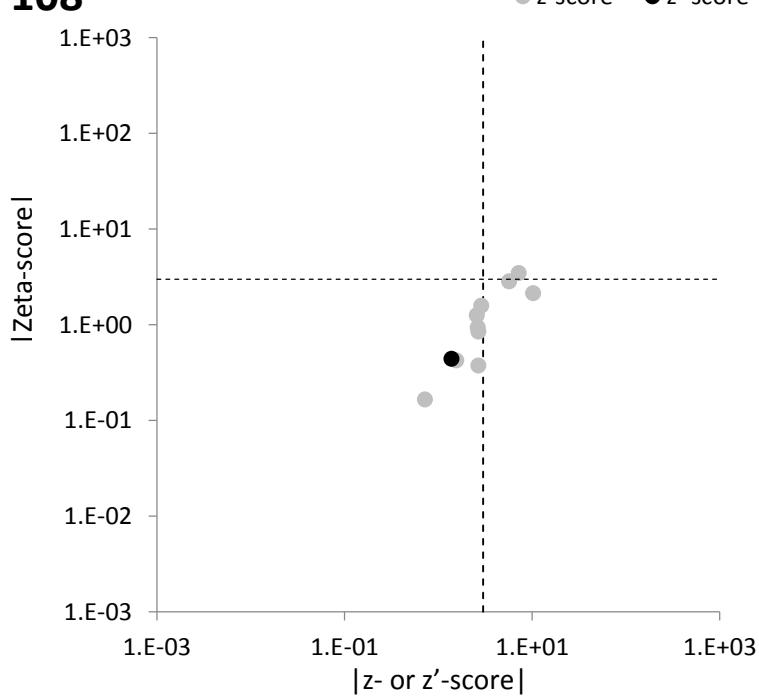


FIG. 123. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 108.

**113**

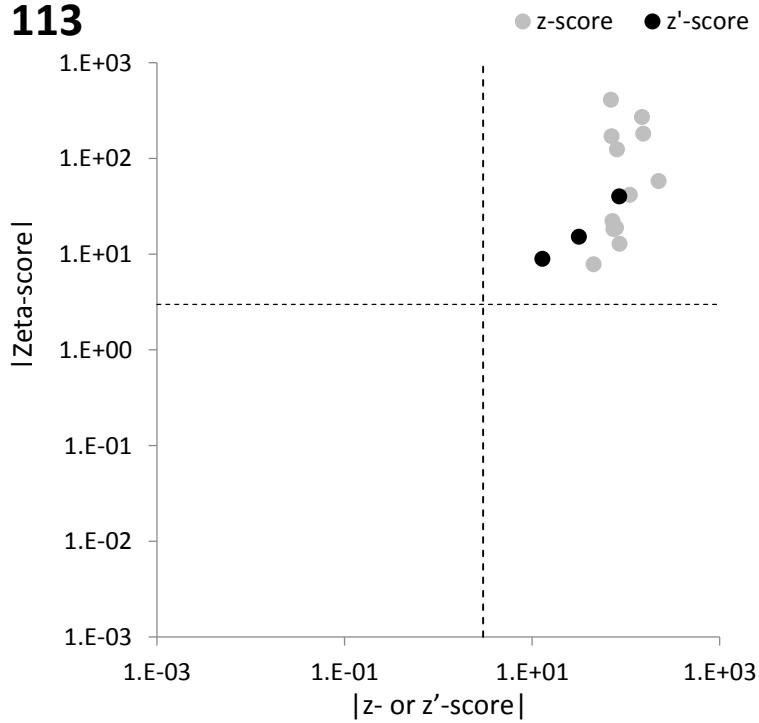


FIG. 124. Combined plots of z- or z'-scores and Zeta-scores for the laboratory with code 113.

**116**

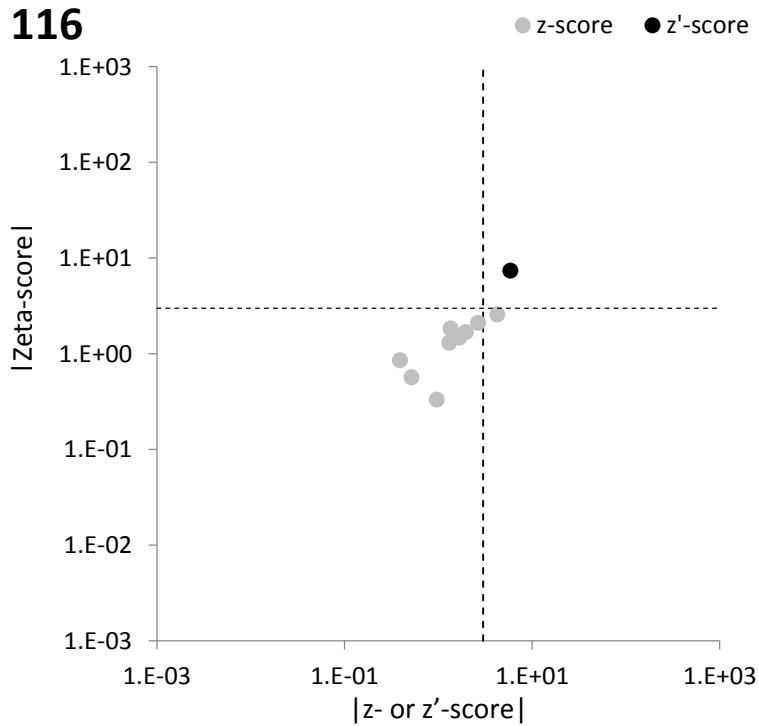


FIG. 125. Combined plots of z- or z'-scores and Zeta-scores for the laboratory with code 116.

**124**

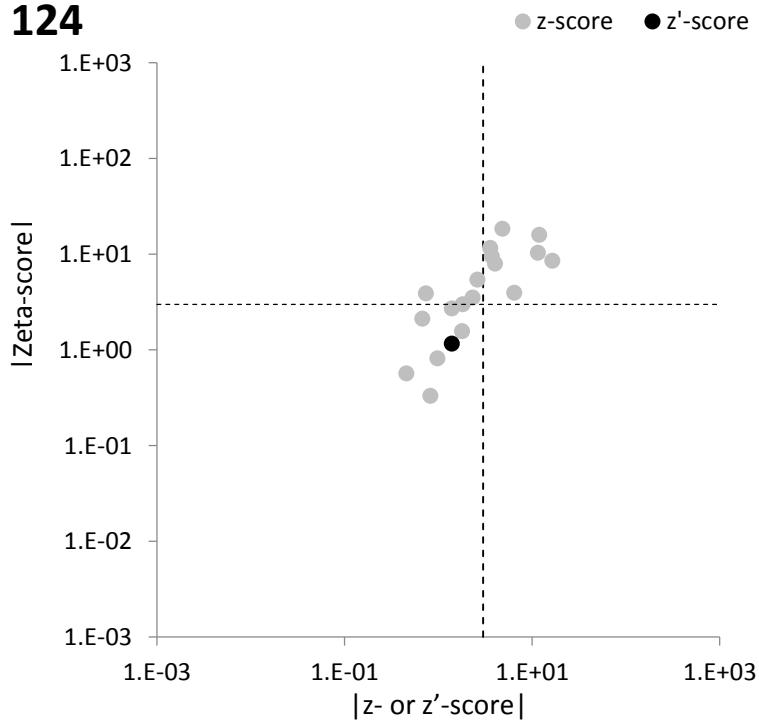


FIG. 126. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 124.

**126**

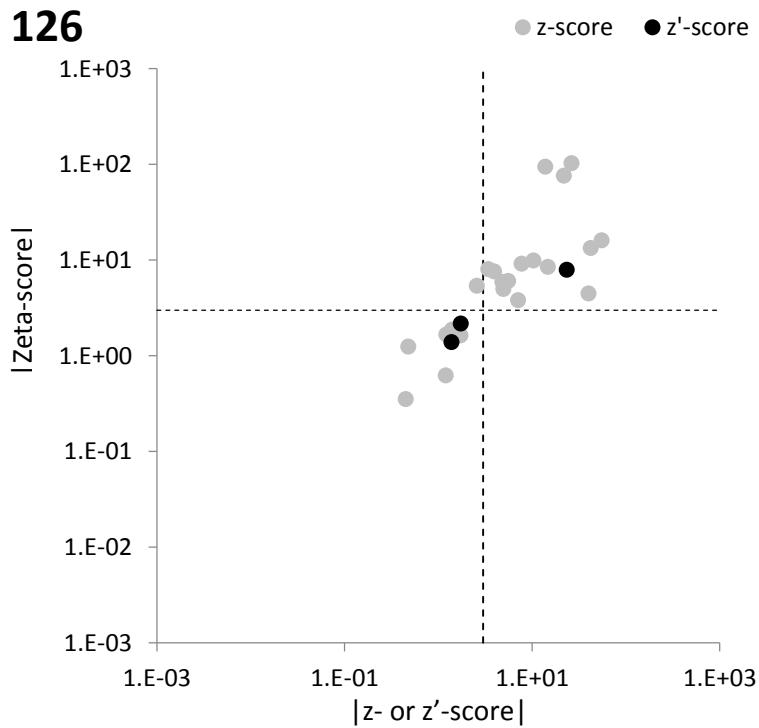


FIG. 127. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 126.

**129**

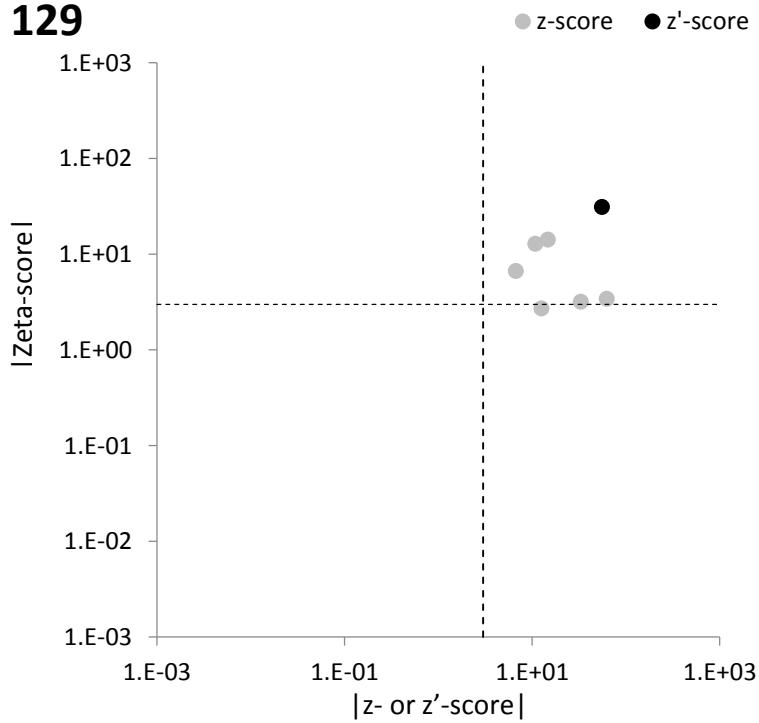


FIG. 128. Combined plots of z- or z'-scores and Zeta-scores for the laboratory with code 129.

**130**

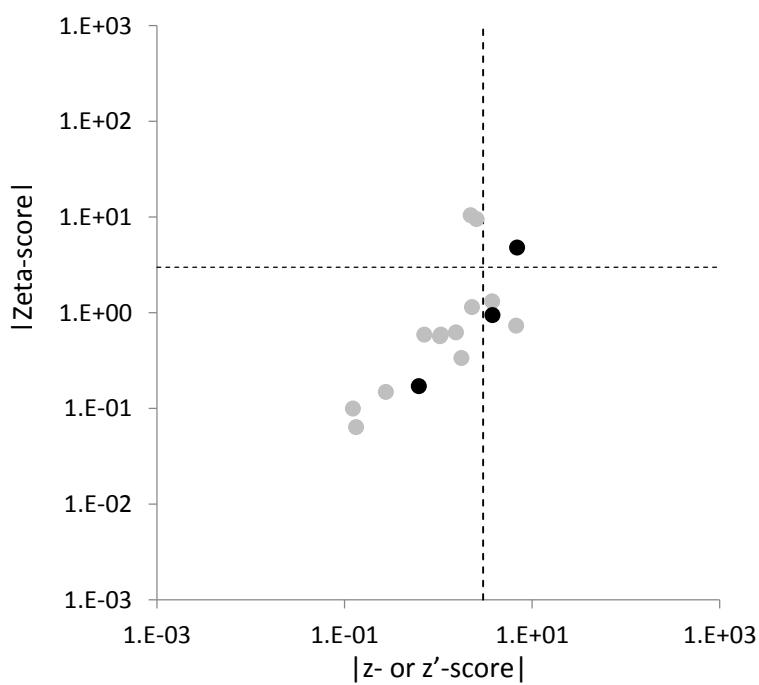


FIG. 129. Combined plots of z- or z'-scores and Zeta-scores for the laboratory with code 130.

**137**

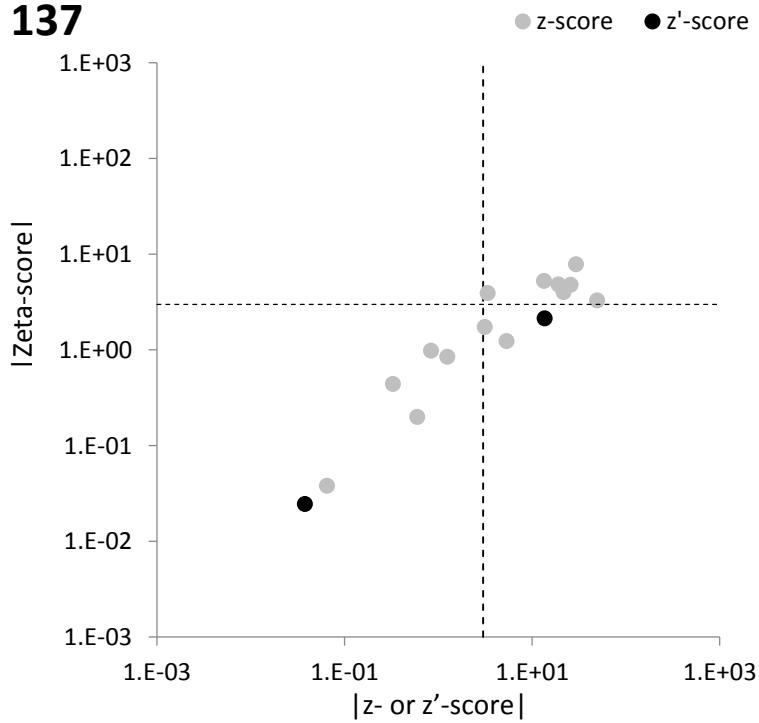


FIG. 130. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 137.

**145**

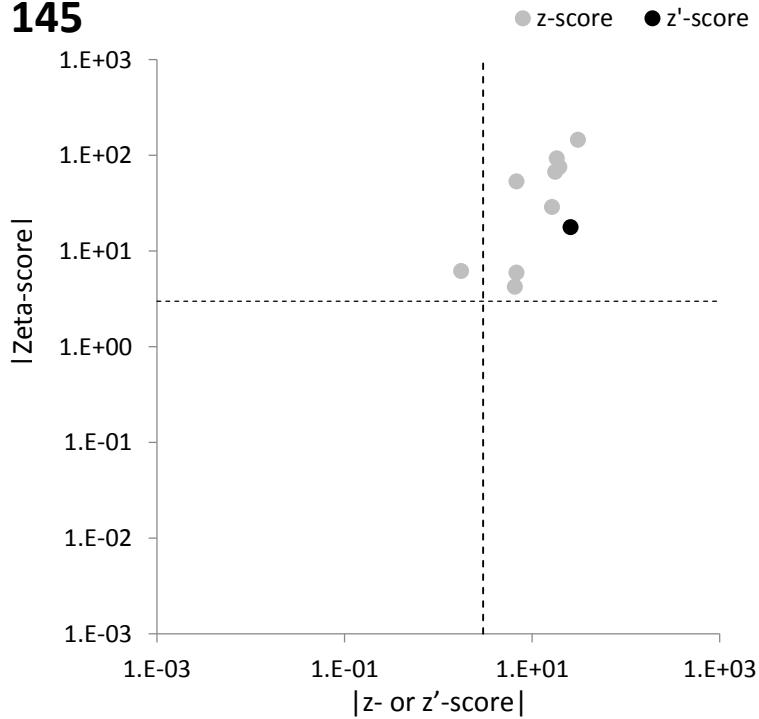


FIG. 131. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 145.

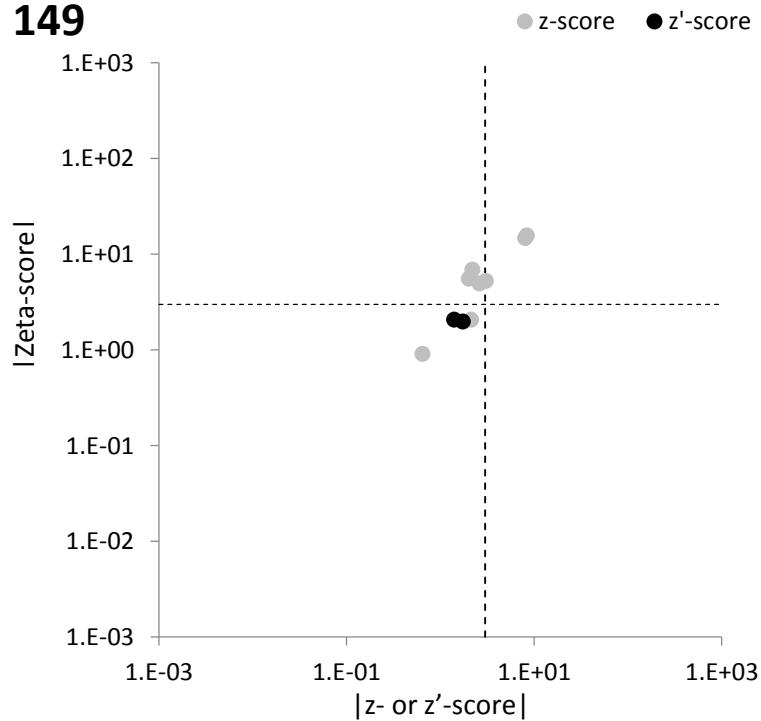
**149**

FIG. 132. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 149.

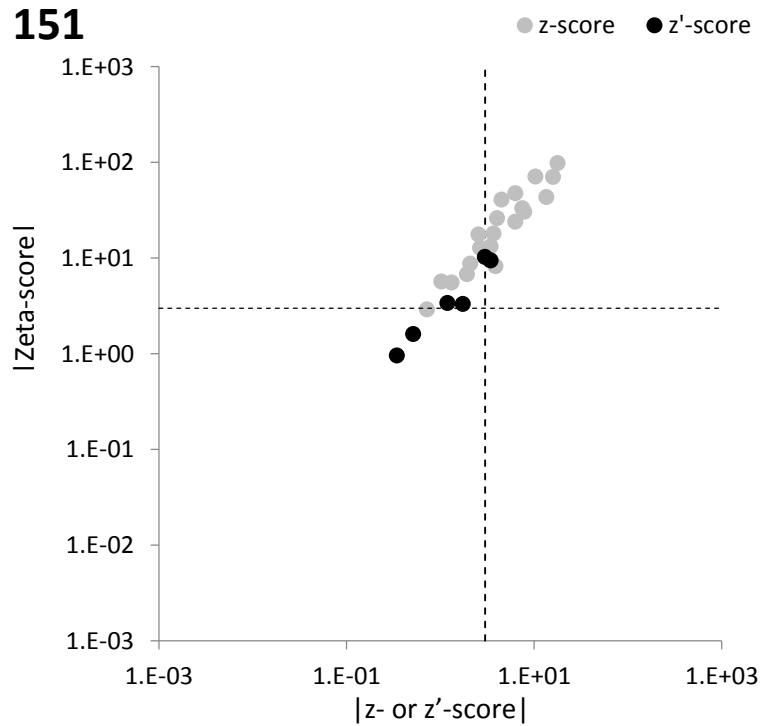
**151**

FIG. 133. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 151.

**152**

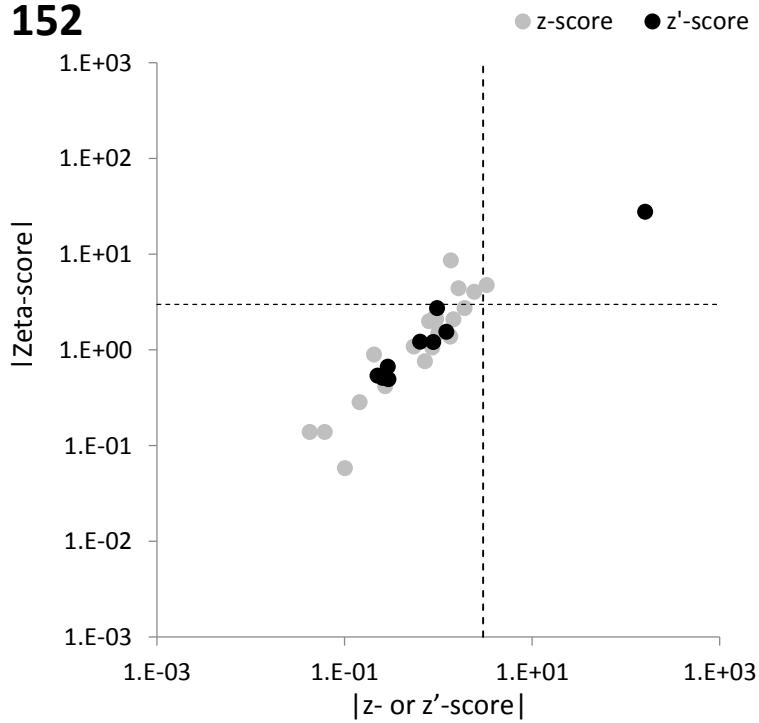


FIG. 134. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 152.

**154**

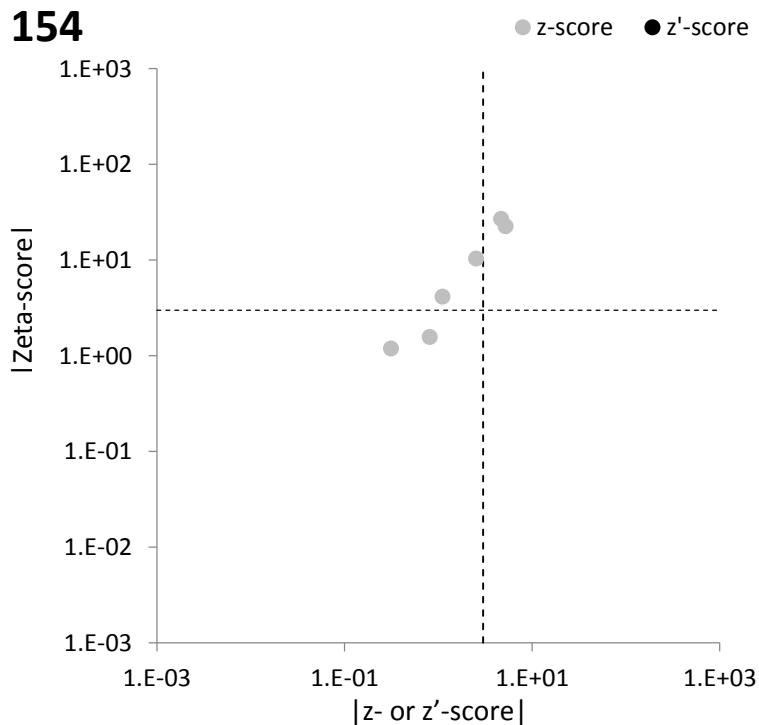


FIG. 135. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 154.

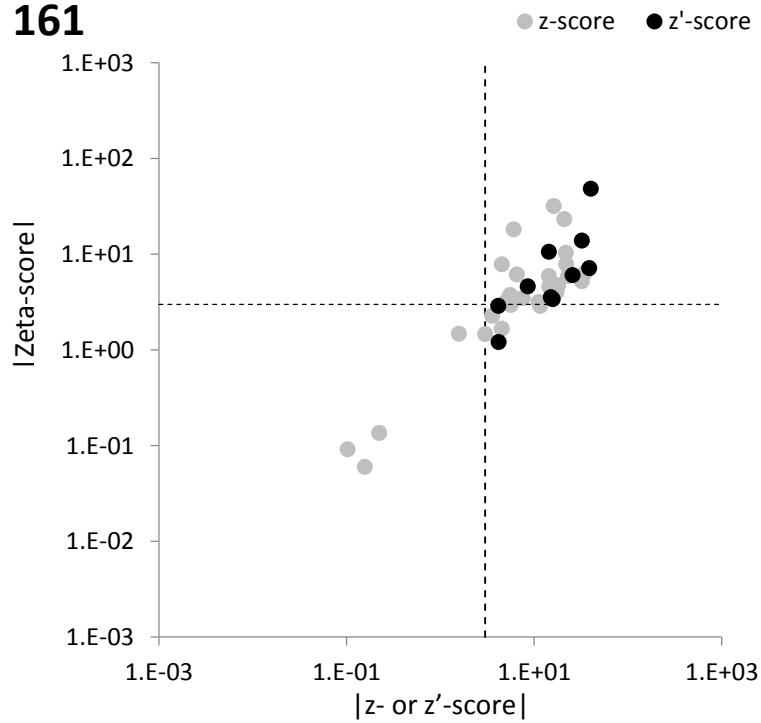
**161**

FIG. 136. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 161.

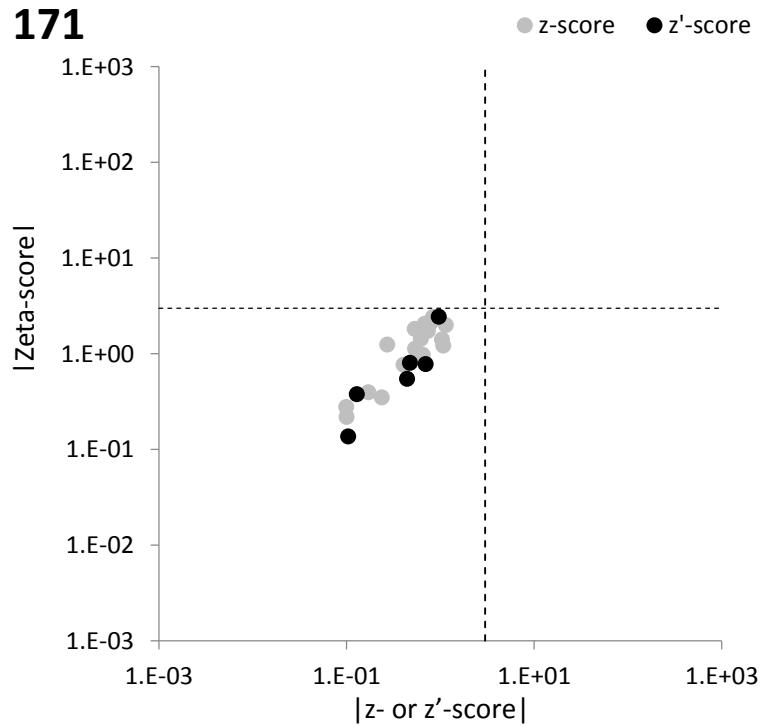
**171**

FIG. 137. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 171.

**172**

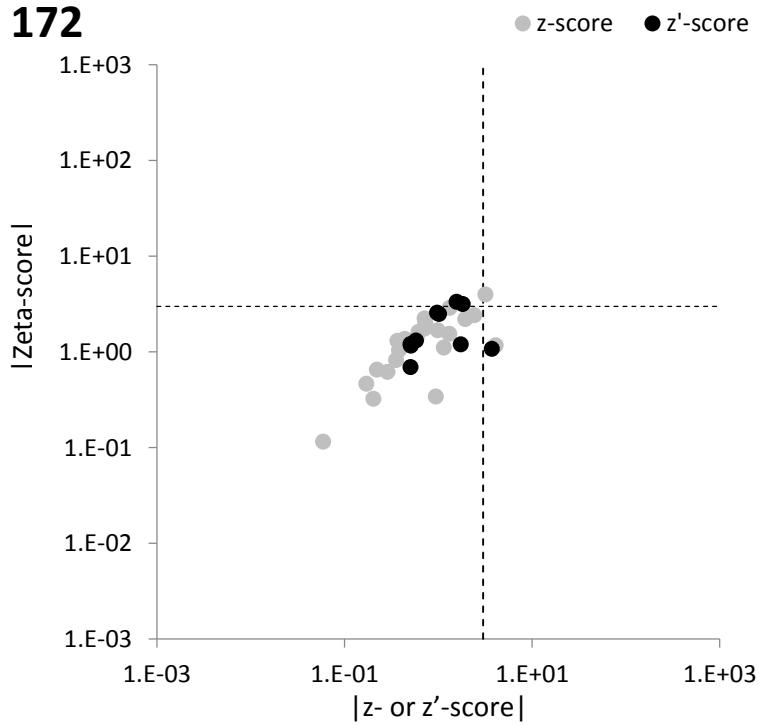


FIG. 138. Combined plots of z- or z'-scores and Zeta-scores for the laboratory with code 172.

**175**

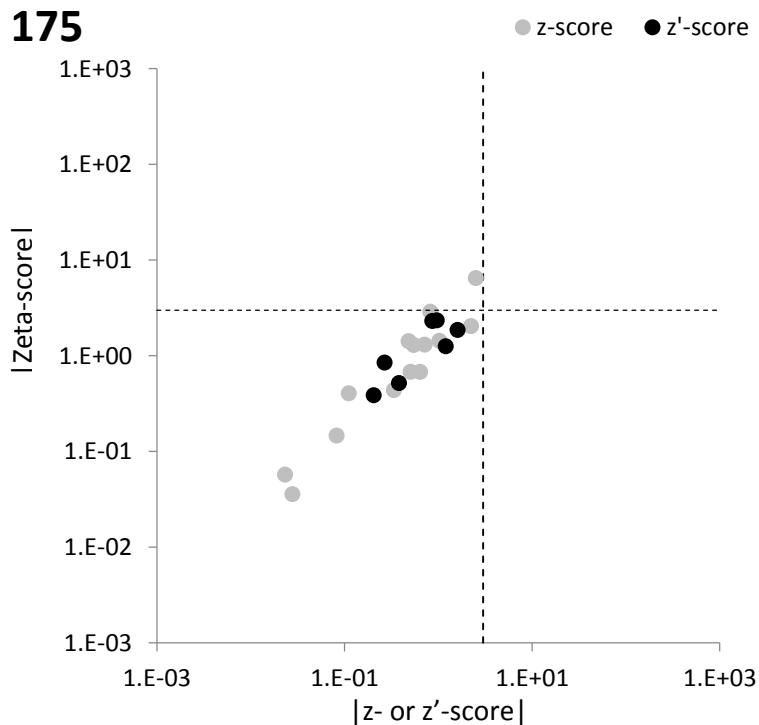


FIG. 139. Combined plots of z- or z'-scores and Zeta-scores for the laboratory with code 175.

**176**

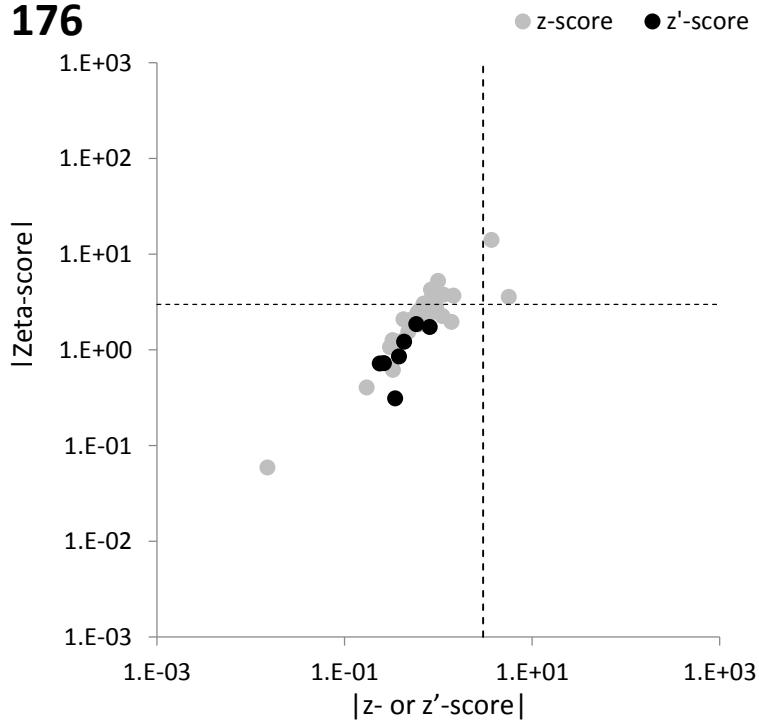


FIG. 140. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 176.

**178**

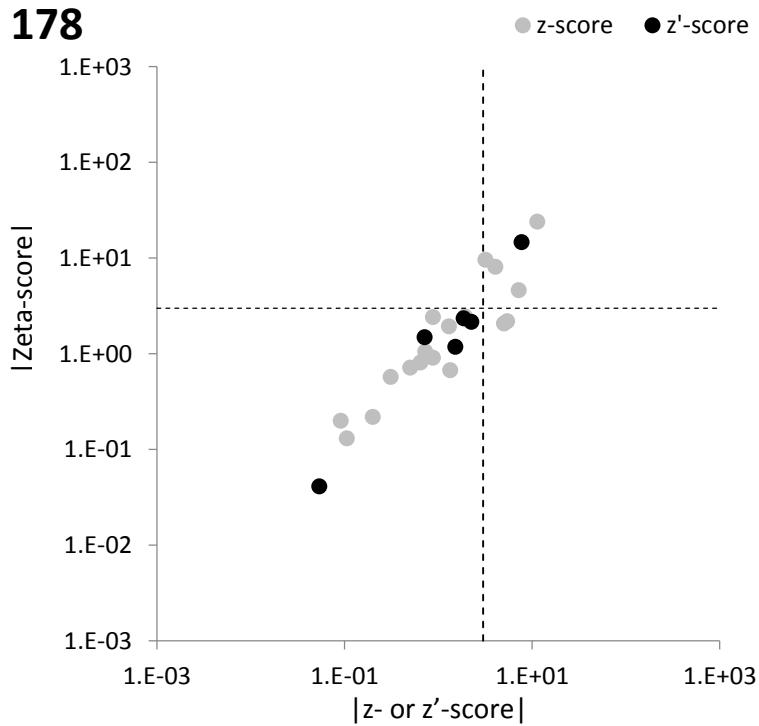


FIG. 141. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 178.

**182**

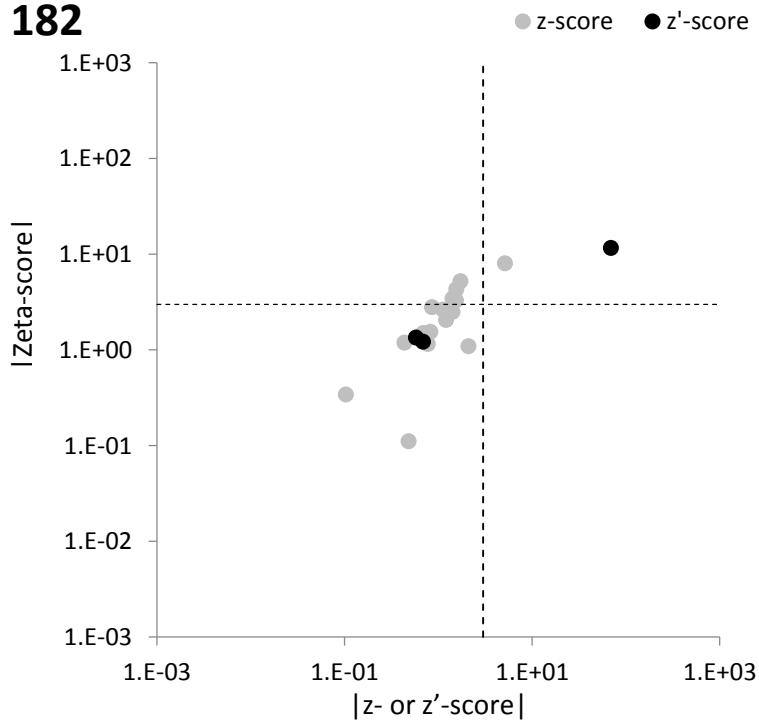


FIG. 142. Combined plots of z- or z'-scores and Zeta-scores for the laboratory with code 182.

**183**

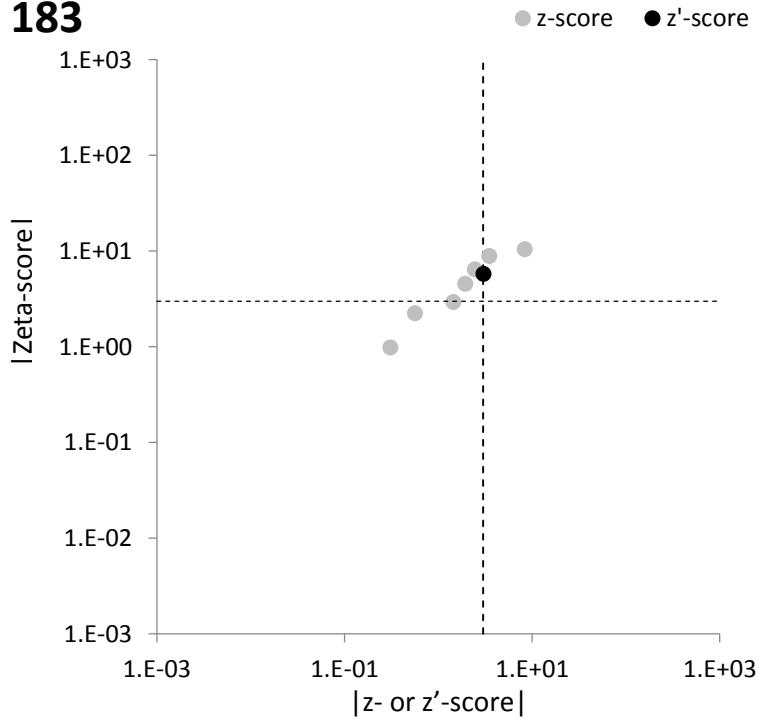


FIG. 143. Combined plots of z- or z'-scores and Zeta-scores for the laboratory with code 183.

**184**

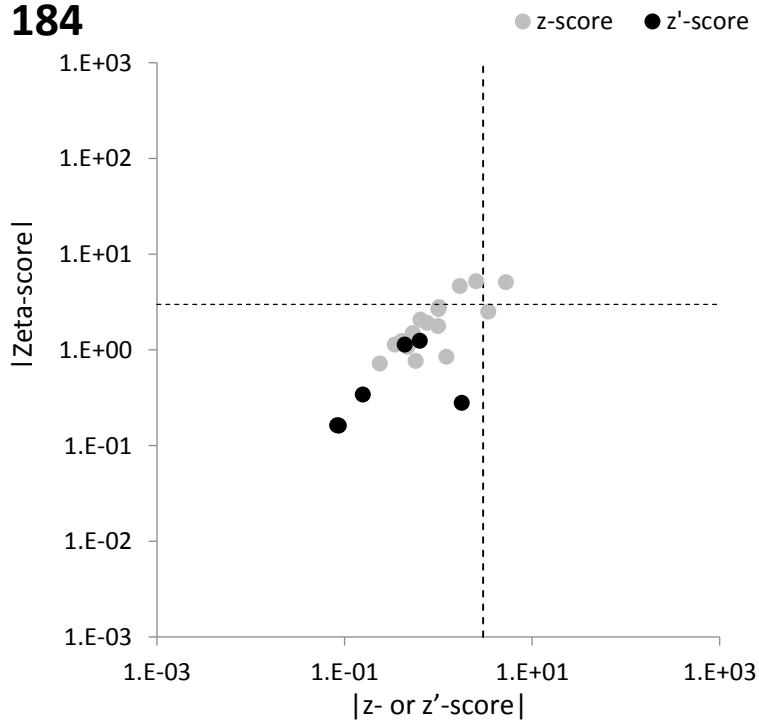


FIG. 144. Combined plots of z- or z'-scores and Zeta-scores for the laboratory with code 184.

**186**

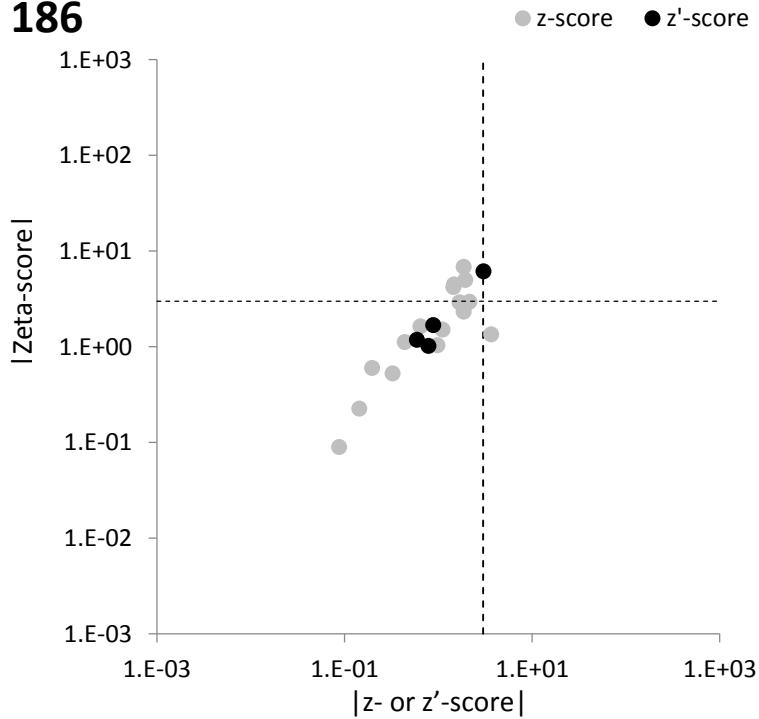


FIG. 145. Combined plots of z- or z'-scores and Zeta-scores for the laboratory with code 186.

**191**

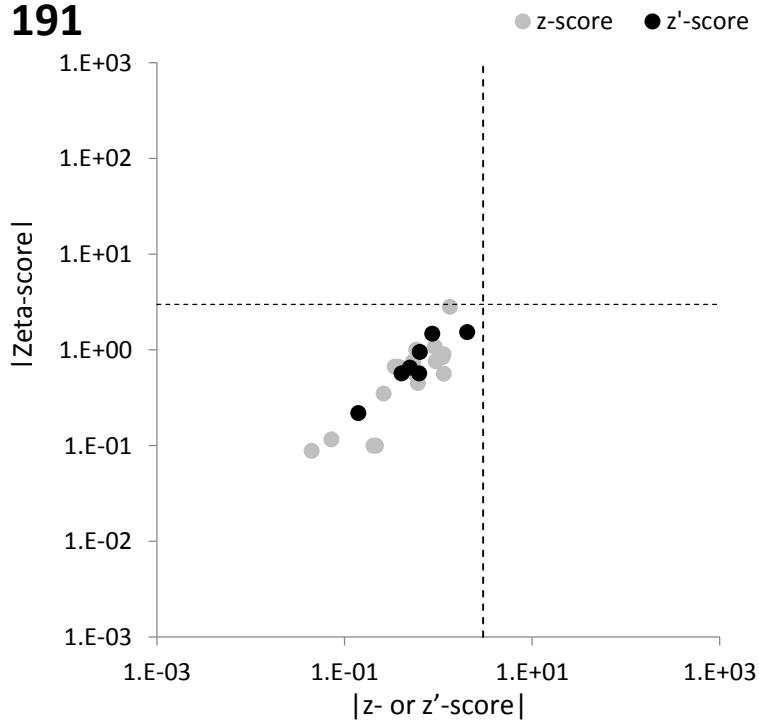


FIG. 146. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 191.

**192**

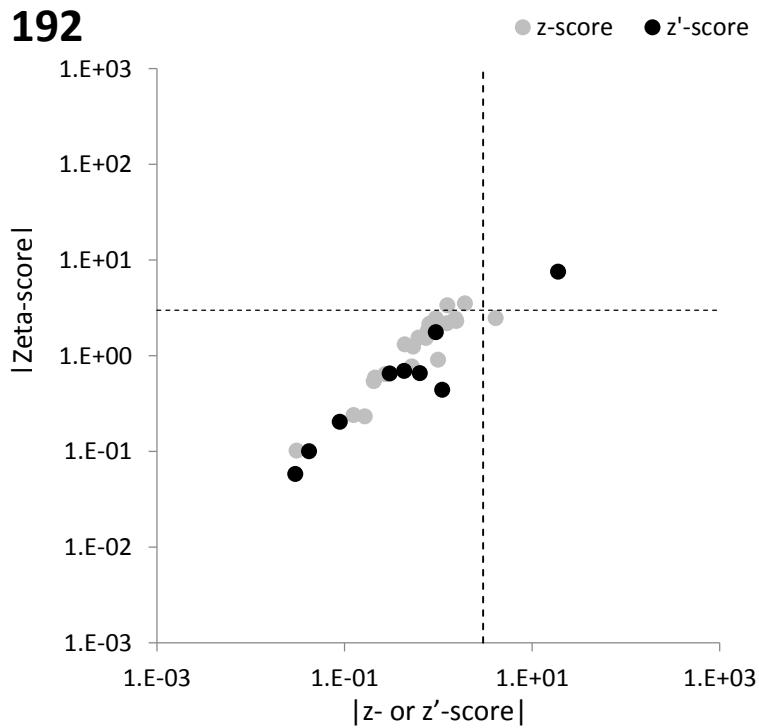


FIG. 147. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 192.

**194**

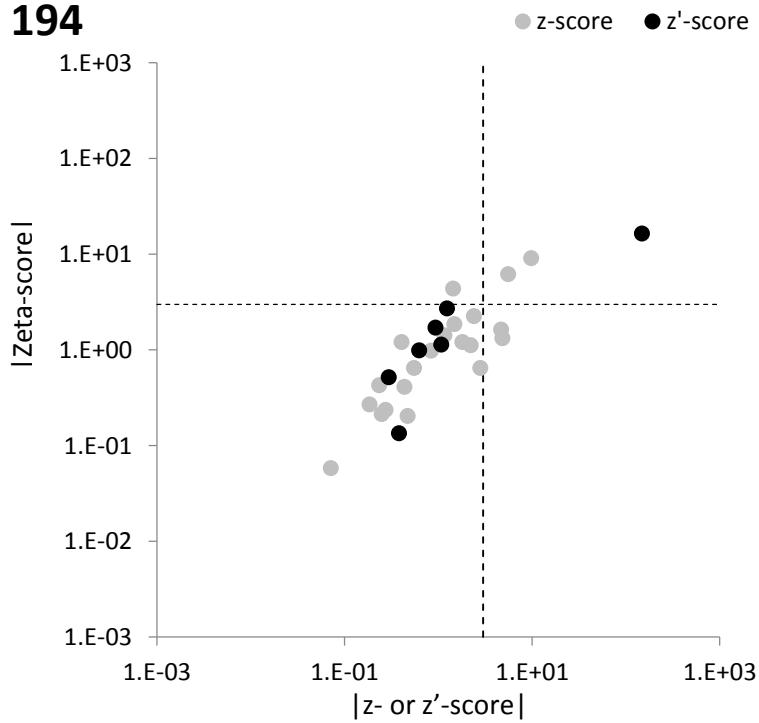


FIG. 148. Combined plots of z- or z'-scores and Zeta-scores for the laboratory with code 194.

**196**

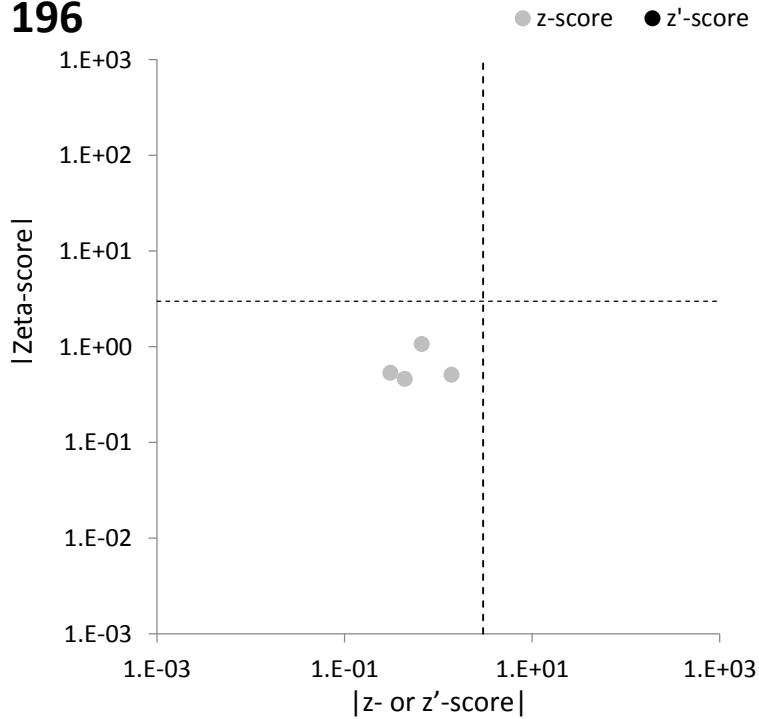


FIG. 149. Combined plots of z- or z'-scores and Zeta-scores for the laboratory with code 196.

**197**

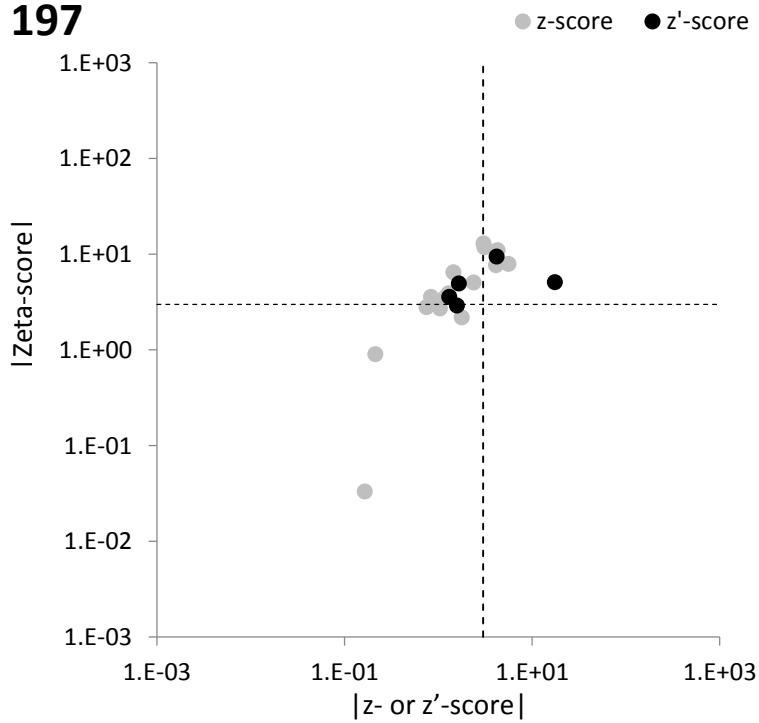


FIG. 150. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 197.

**199**

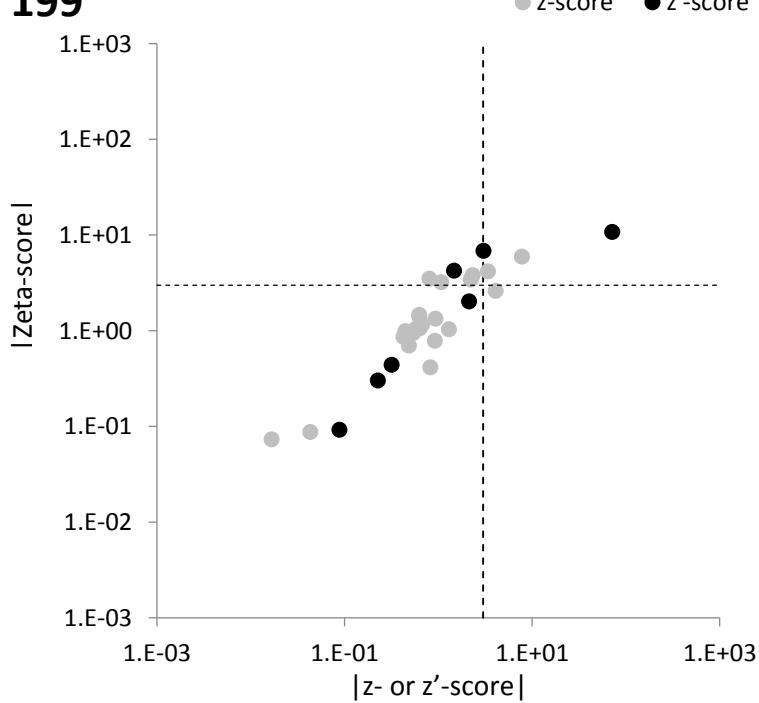


FIG. 151. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 199.

**202**

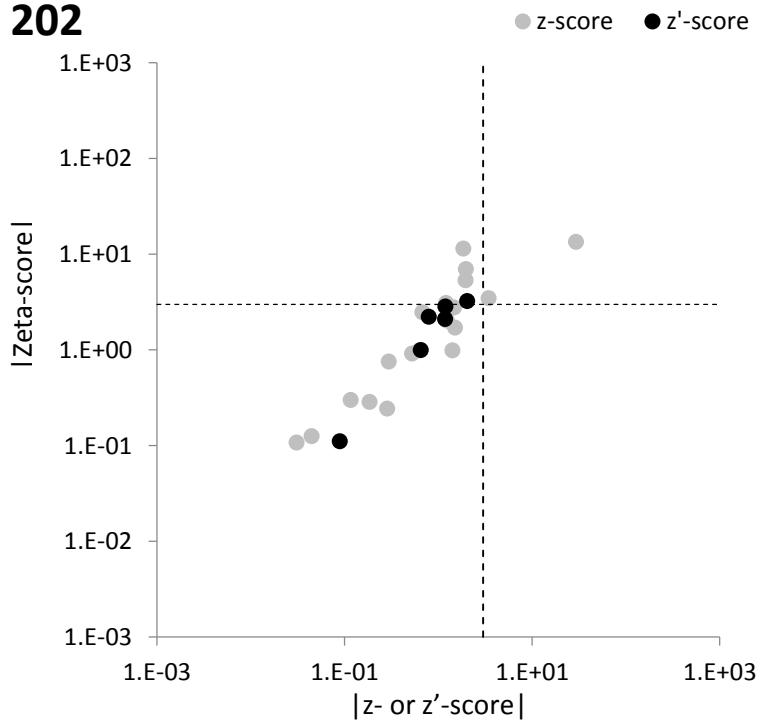


FIG. 152. Combined plots of z- or z'-scores and Zeta-scores for the laboratory with code 202.

**203**

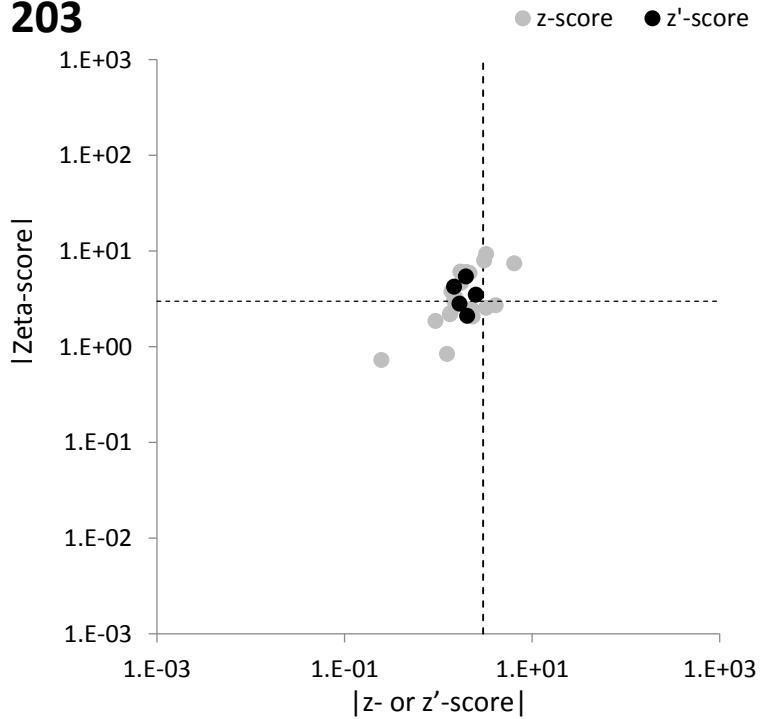


FIG. 153. Combined plots of z- or z'-scores and Zeta-scores for the laboratory with code 203.

**204**

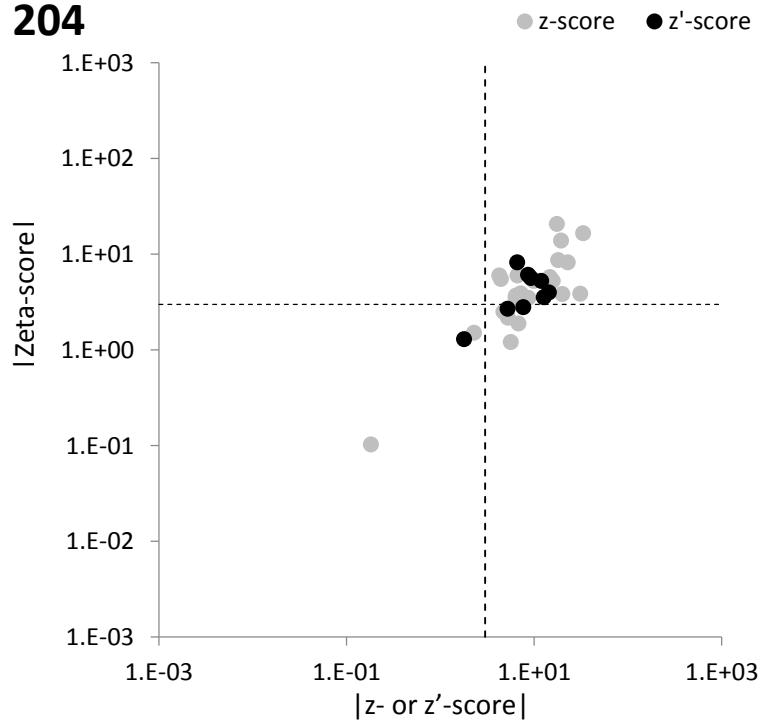


FIG. 154. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 204.

**205**

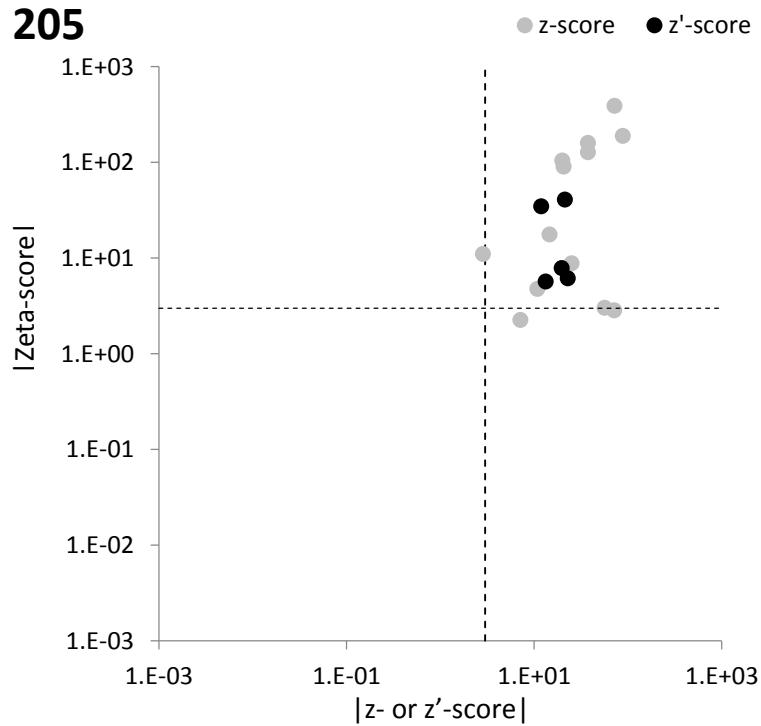


FIG. 155. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 205.

**209**

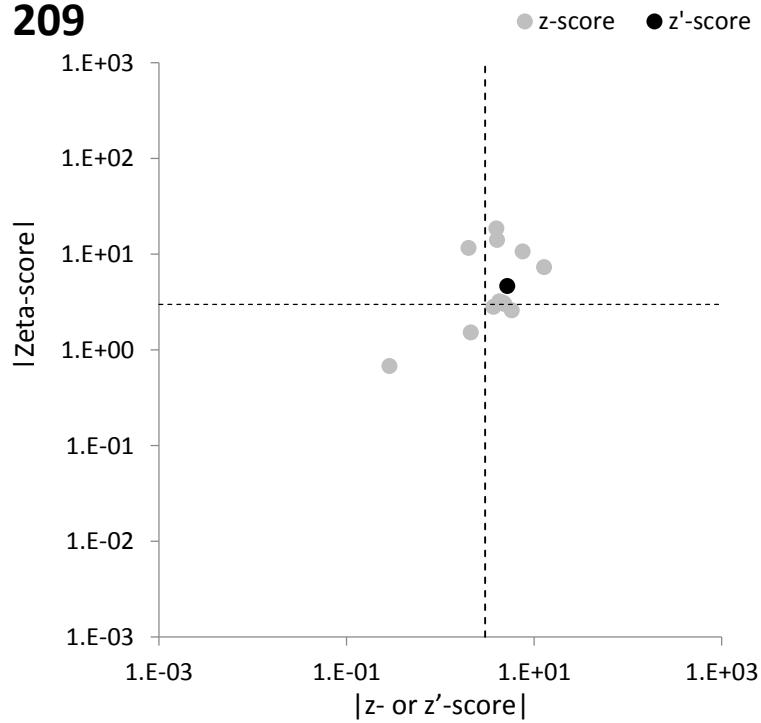


FIG. 156. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 209.

**215**

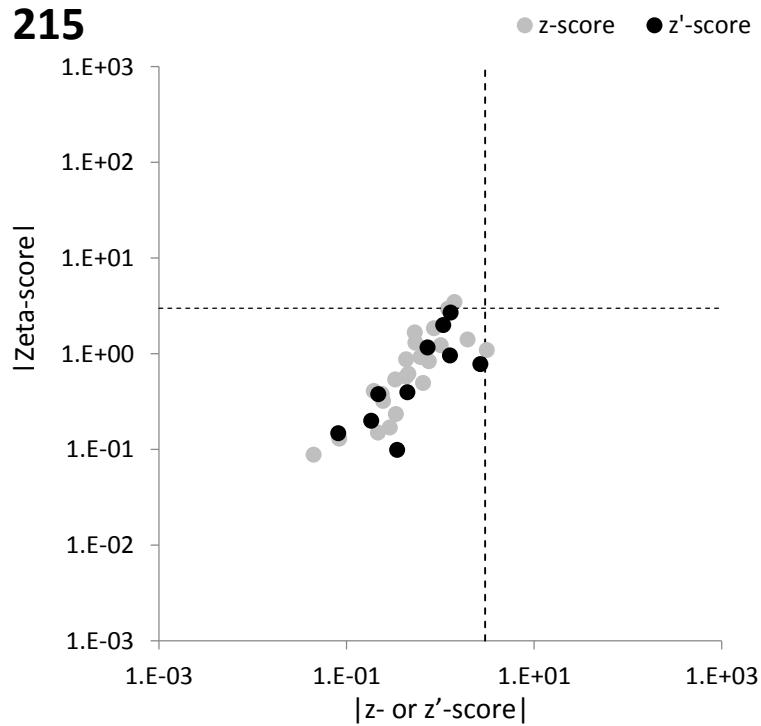


FIG. 157. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 215.

**217**

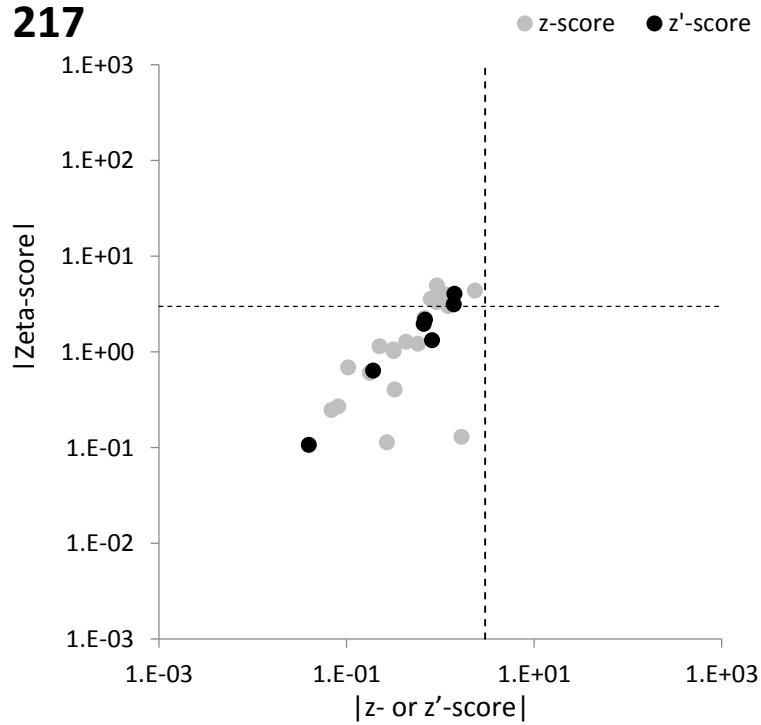


FIG. 158. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 217.

**219**

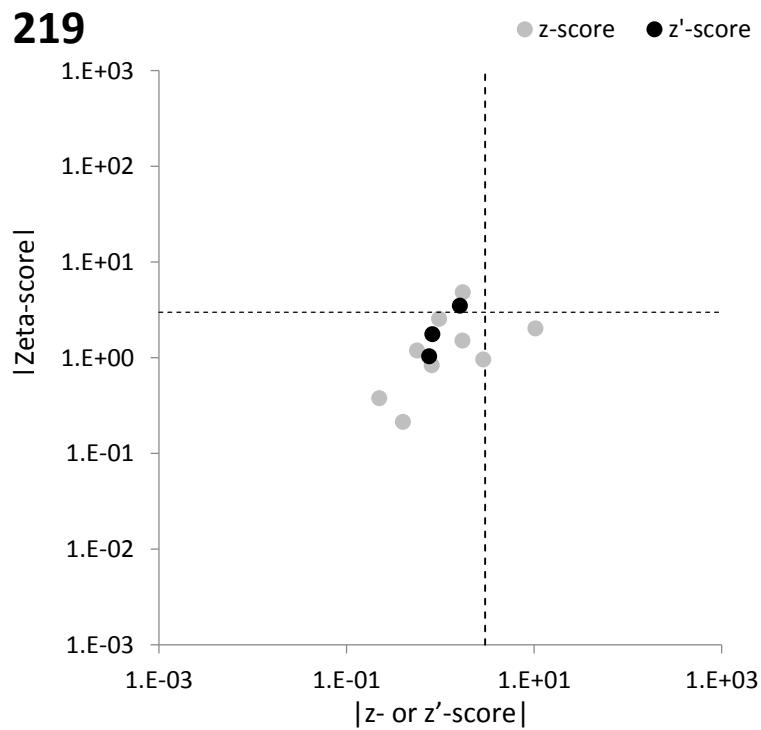


FIG. 159. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 219.

**221**

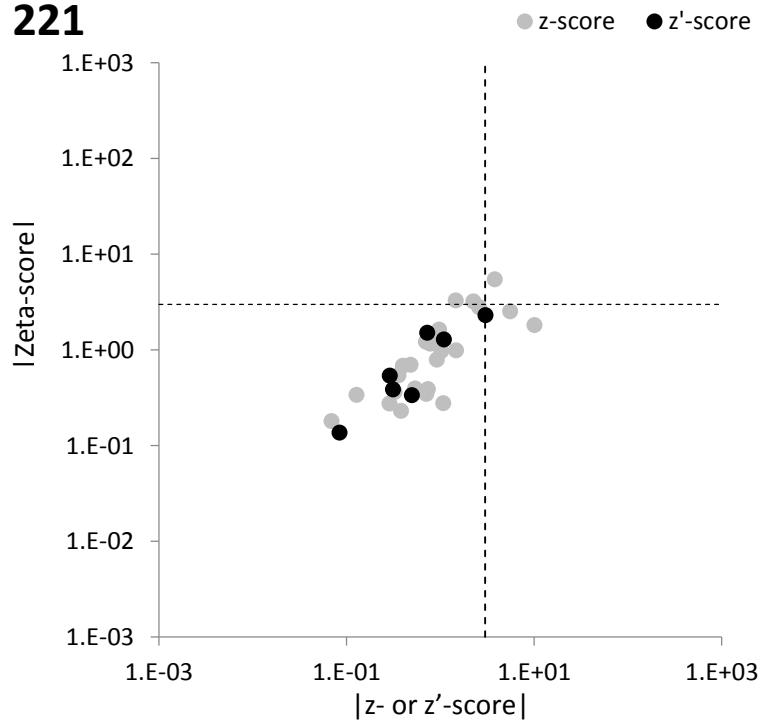


FIG. 160. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 221.

**225**

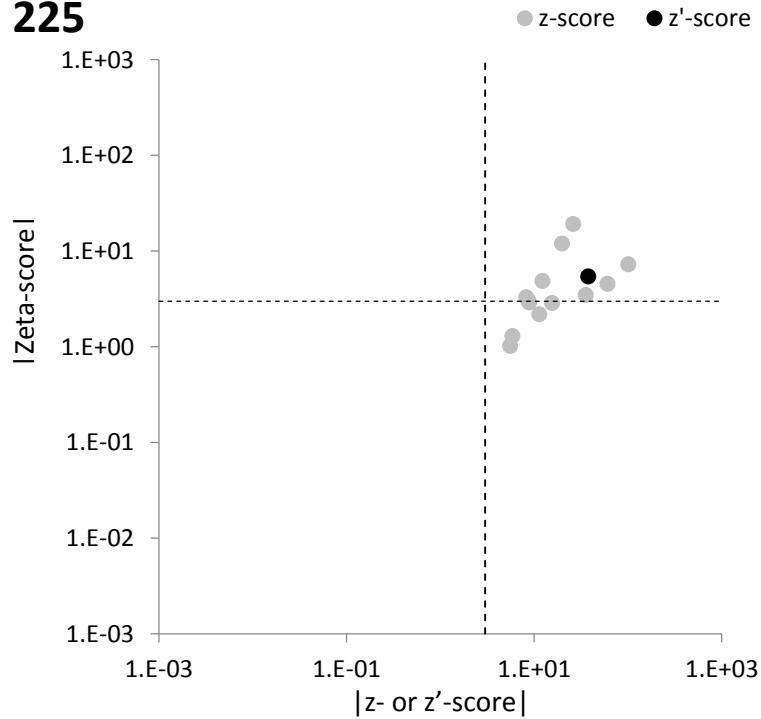


FIG. 161. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 225.

**227**

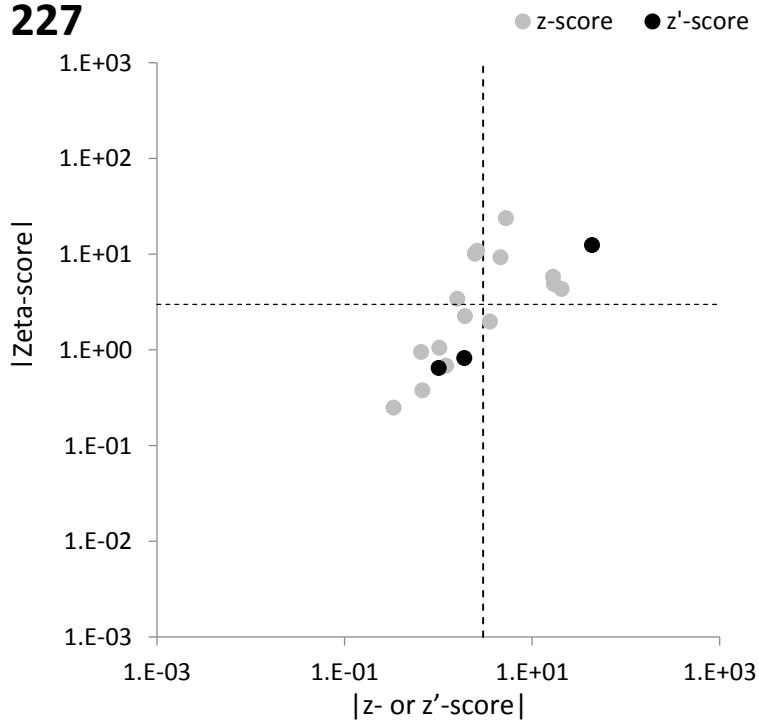


FIG. 162. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 227.

**228**

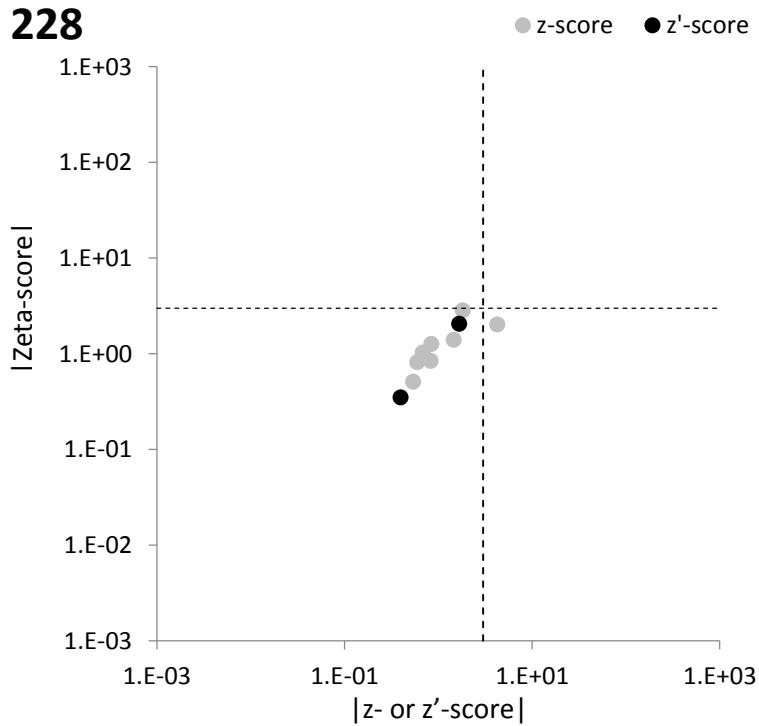


FIG. 163. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 228.

**229**

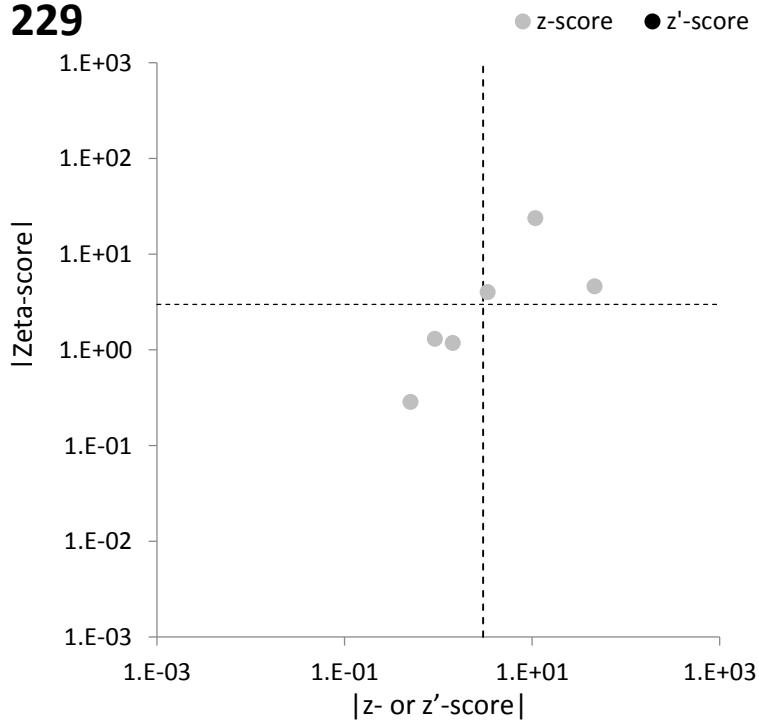


FIG. 164. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 229.

**230**

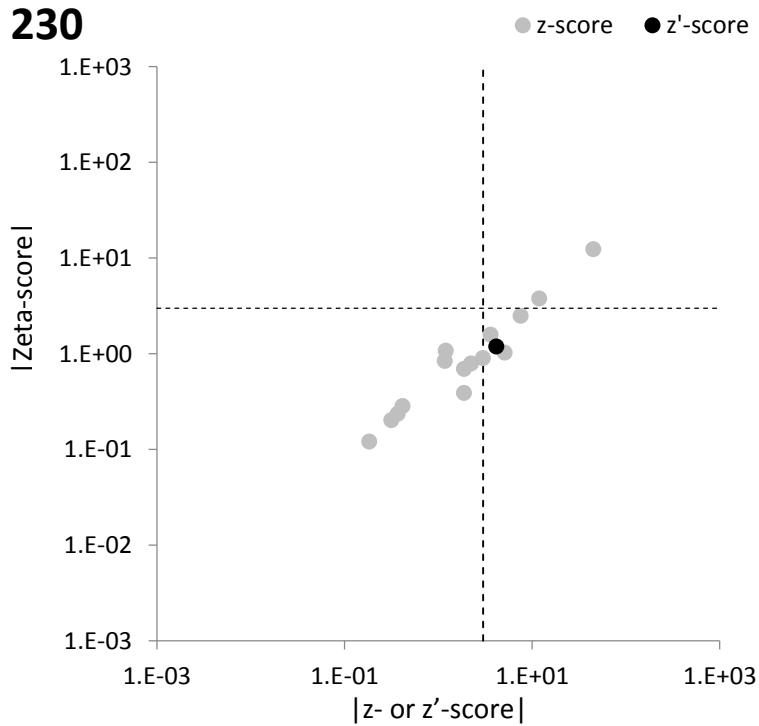


FIG. 165. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 230.

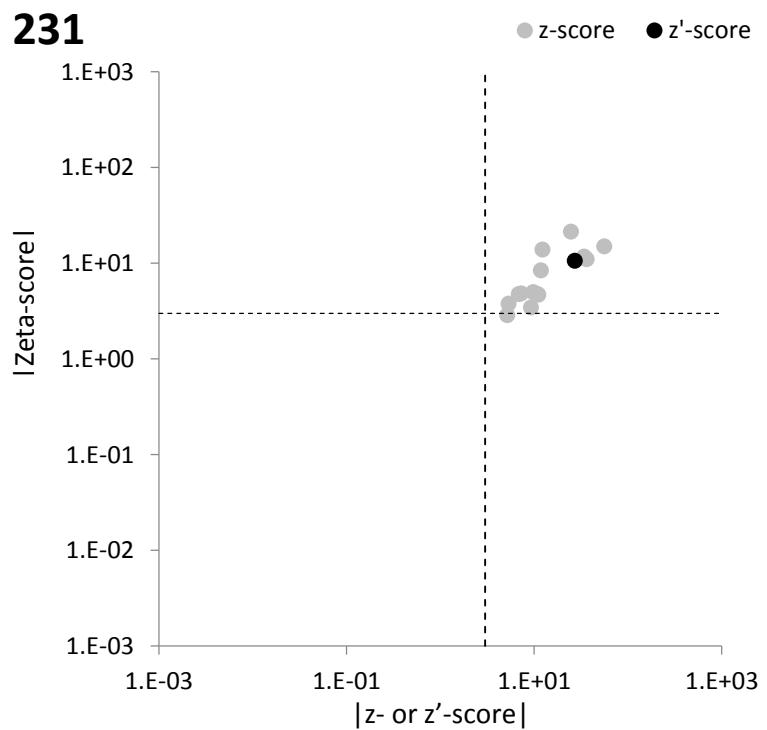


FIG. 166. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 231.

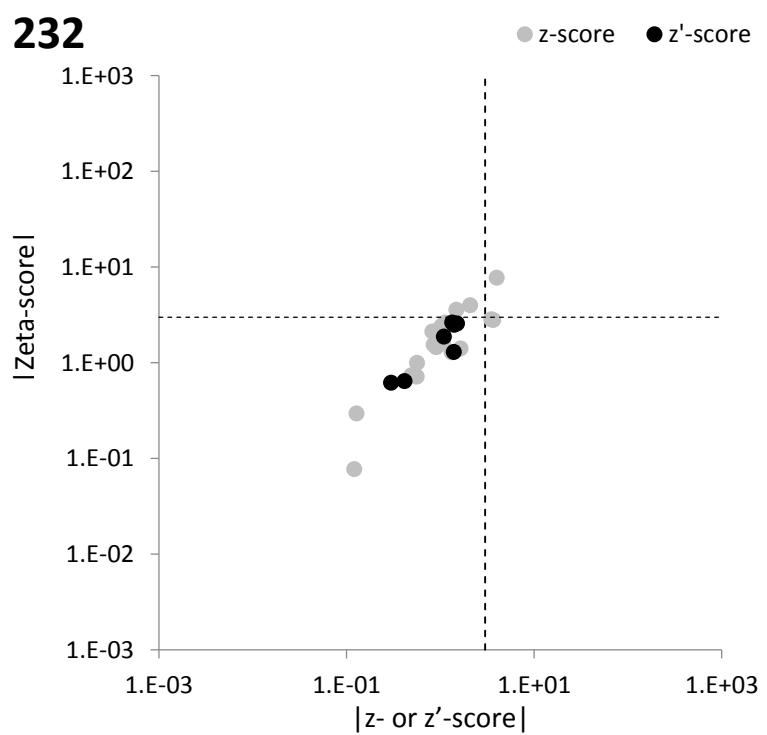


FIG. 167. Combined plots of  $z$ - or  $z'$ -scores and Zeta-scores for the laboratory with code 232.

**233**

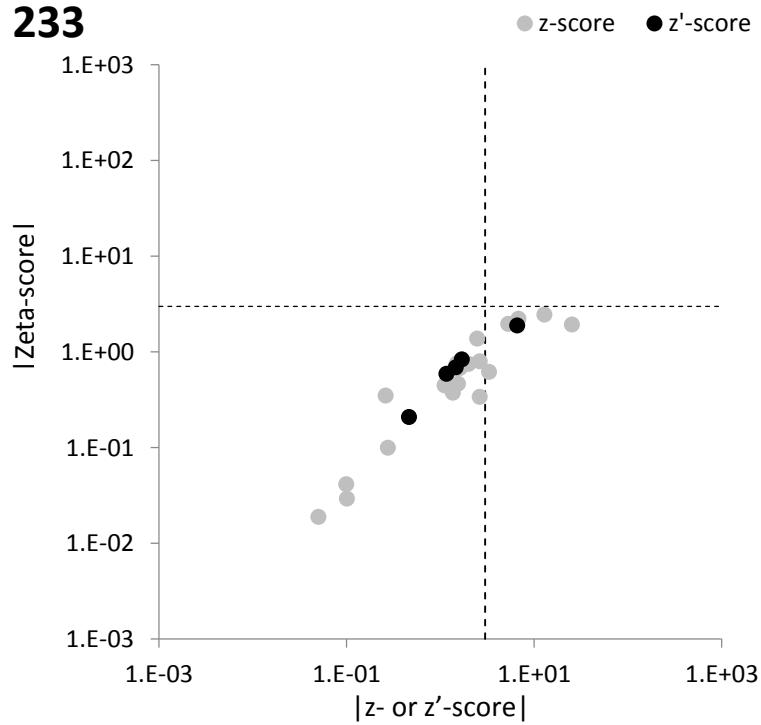


TABLE 5. SUMMARY OF THE PERFORMANCE INDICATORS FOR EACH PARTICIPANT.

Part. code	Number of results	Number of values < 3			Number of values $\geq 3$		
		<i>z</i>	<i>z'</i>	<i>Zeta</i>	<i>z</i>	<i>z'</i>	<i>Zeta</i>
36	13	4	1	5	5	2	7
39	10	2	0	5	7	0	4
44	19	1	0	10	12	3	6
53	12	2	1	3	7	0	7
54	11	7	0	8	2	1	2
55	22	17	4	18	0	0	3
65	30	2	0	6	18	6	20
68	25	2	0	0	15	2	19
73	6	0	0	0	5	1	6
74	15	10	1	12	4	0	3
75	16	9	1	4	5	0	11
77	32	2	0	6	18	6	20
78	19	6	0	3	9	1	13
79	11	3	0	7	8	0	4
84	8	3	2	5	2	1	3
85	21	3	1	8	15	2	13
89	12	4	0	3	7	0	8
91	2	2	0	2	0	0	0
93	6	0	0	0	5	1	6
94	24	16	0	11	4	1	10
95	10	6	0	5	3	1	5
102	14	3	1	5	9	0	8
105	33	12	2	15	10	4	13
108	12	7	1	10	3	0	1
113	19	0	0	0	14	3	17
116	11	8	0	9	1	1	1
124	24	10	1	8	9	2	14
126	31	7	2	8	15	1	17
129	10	0	0	1	8	1	8
130	17	11	1	13	2	3	4
137	17	5	1	9	9	1	7
145	13	1	0	0	8	3	12
149	11	5	2	4	3	0	6
151	34	7	5	3	15	2	26
152	32	20	8	25	1	1	5
154	10	4	0	2	5	0	7
161	48	5	0	11	25	10	29
171	26	18	7	25	0	0	0
172	40	22	9	31	2	1	3
175	22	14	7	20	0	0	1
176	36	22	7	23	2	0	8

178	26	12	5	19	6	1	5
182	22	15	2	13	1	1	6
183	12	5	0	3	2	2	6
184	24	15	6	20	2	0	3
186	22	15	3	15	2	1	6
191	26	18	7	25	0	0	0
192	39	22	8	29	1	1	3
194	32	18	6	25	4	1	4
196	6	4	0	4	0	1	1
197	23	11	3	6	5	2	15
199	31	20	5	21	3	2	9
202	28	17	6	18	2	1	8
203	26	14	5	11	5	0	13
204	43	2	1	10	23	8	24
205	21	1	0	2	13	6	18
209	14	3	0	4	9	1	9
215	37	22	10	32	1	0	1
217	28	19	7	18	0	1	9
219	12	8	3	10	1	0	2
221	37	22	6	29	3	1	3
225	15	0	0	5	13	1	9
227	21	9	2	9	6	1	9
228	10	7	2	10	1	0	0
229	7	4	0	4	3	0	3
230	17	10	0	14	5	1	2
231	16	0	0	1	14	1	14
232	29	17	7	24	3	0	3
233	27	14	4	24	5	1	0
234	20	3	2	8	9	1	7

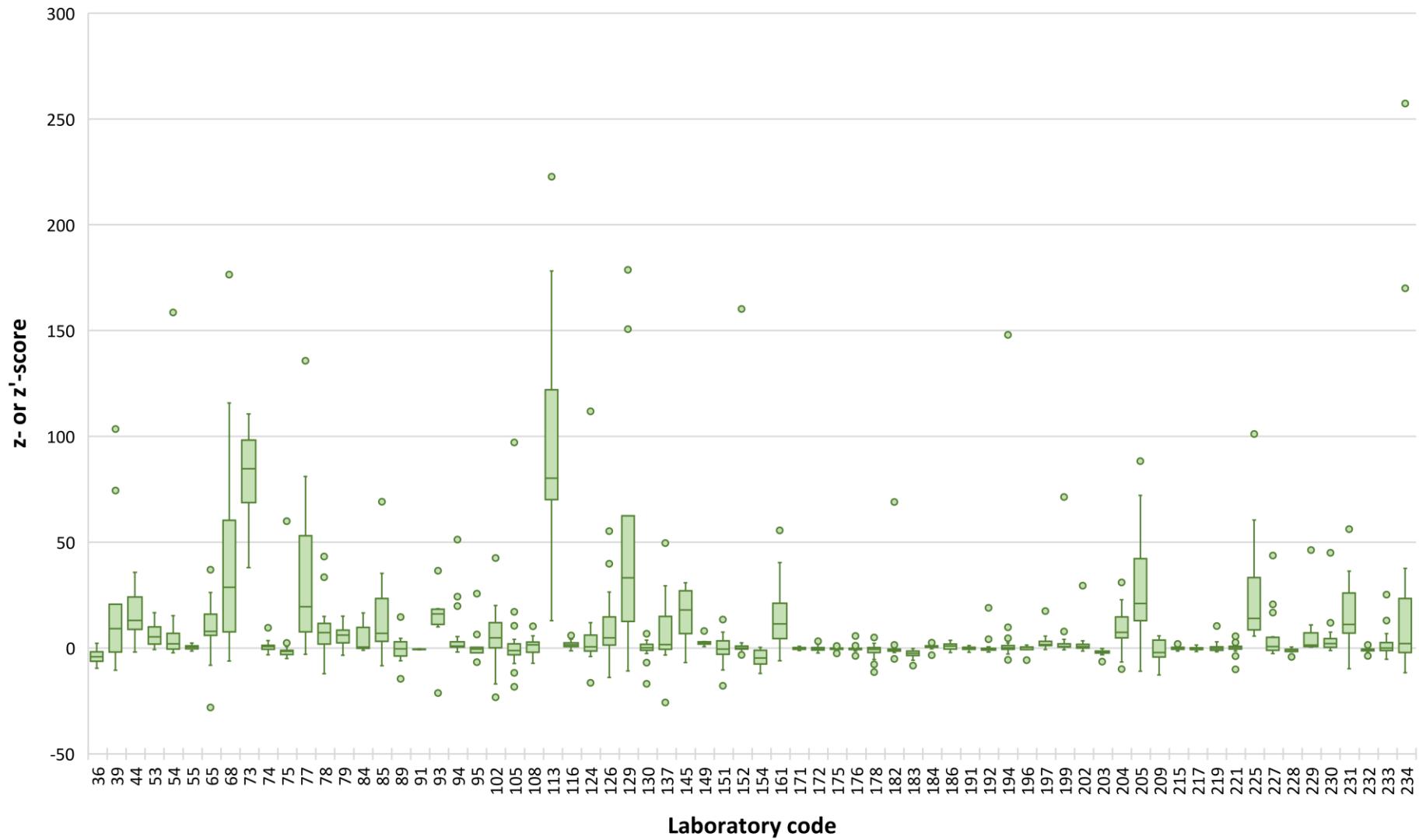


FIG. 170. Box-and-whisker plot of the  $z$ - and  $z'$ -scores for each participant.

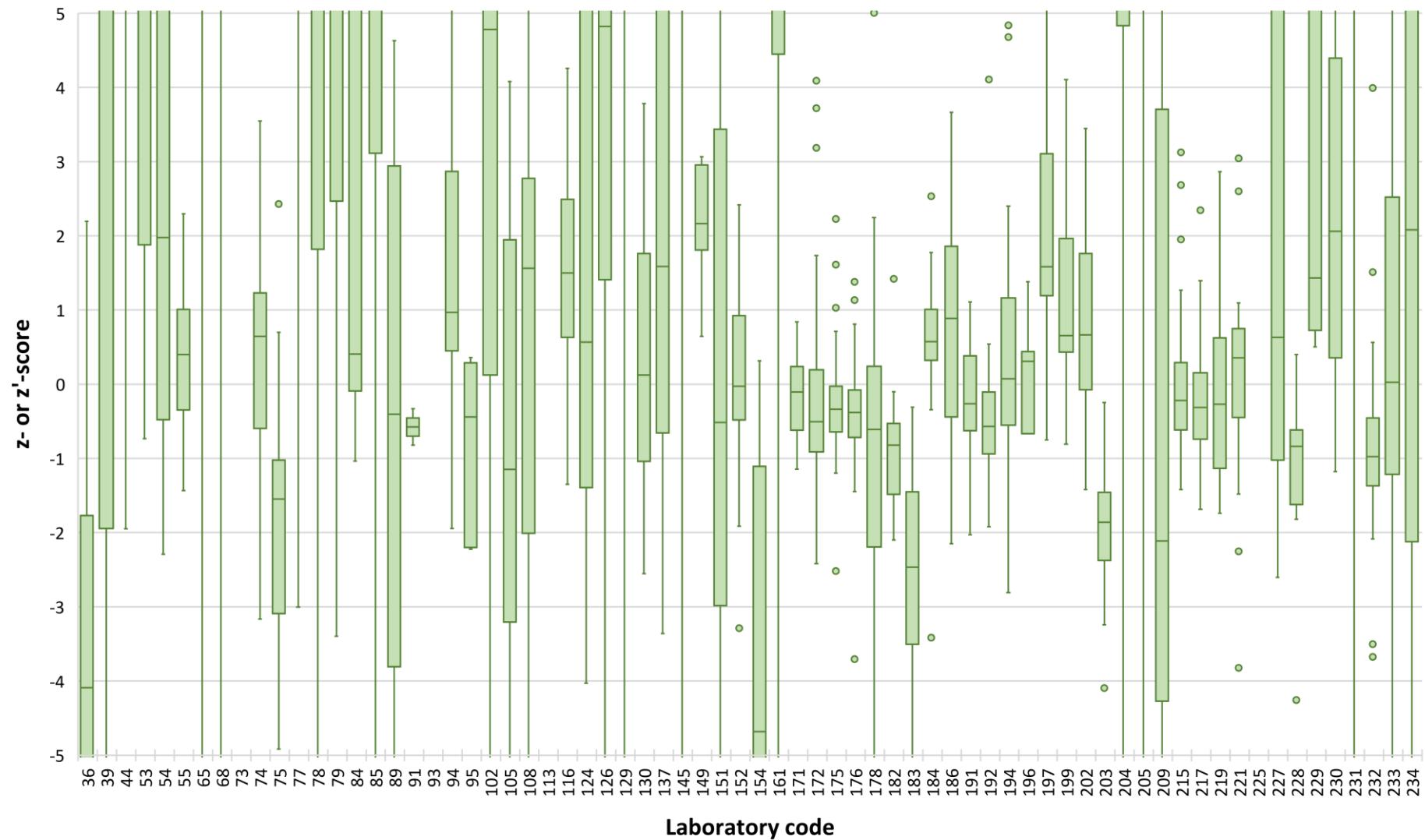
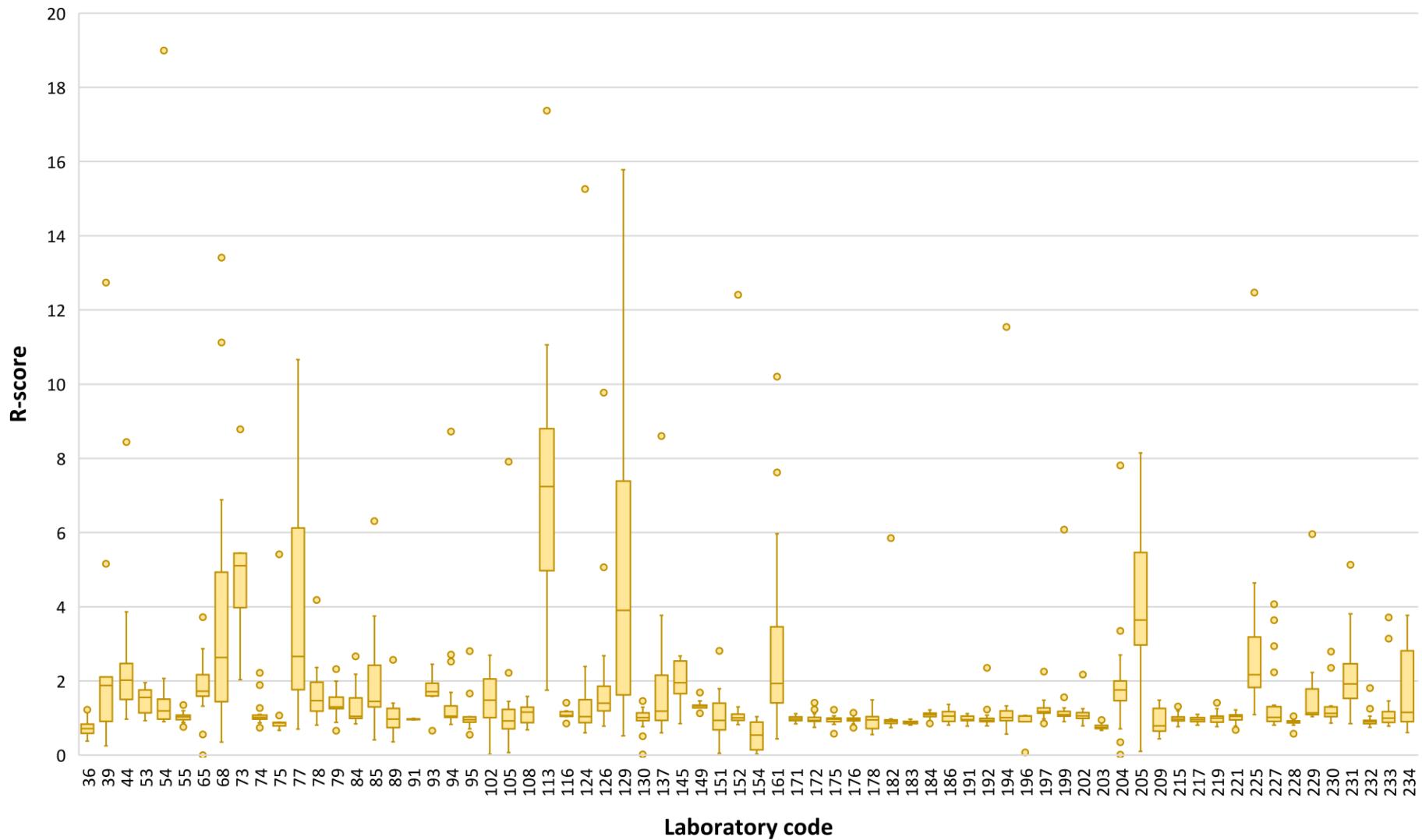


FIG. 171. Box-and-whisker plot of the *z*- and *z'*-scores for each participant (vertical scale reduced to the range -5÷5).



*FIG. 172. Box-and-whisker plot of the R-scores for each participant.*

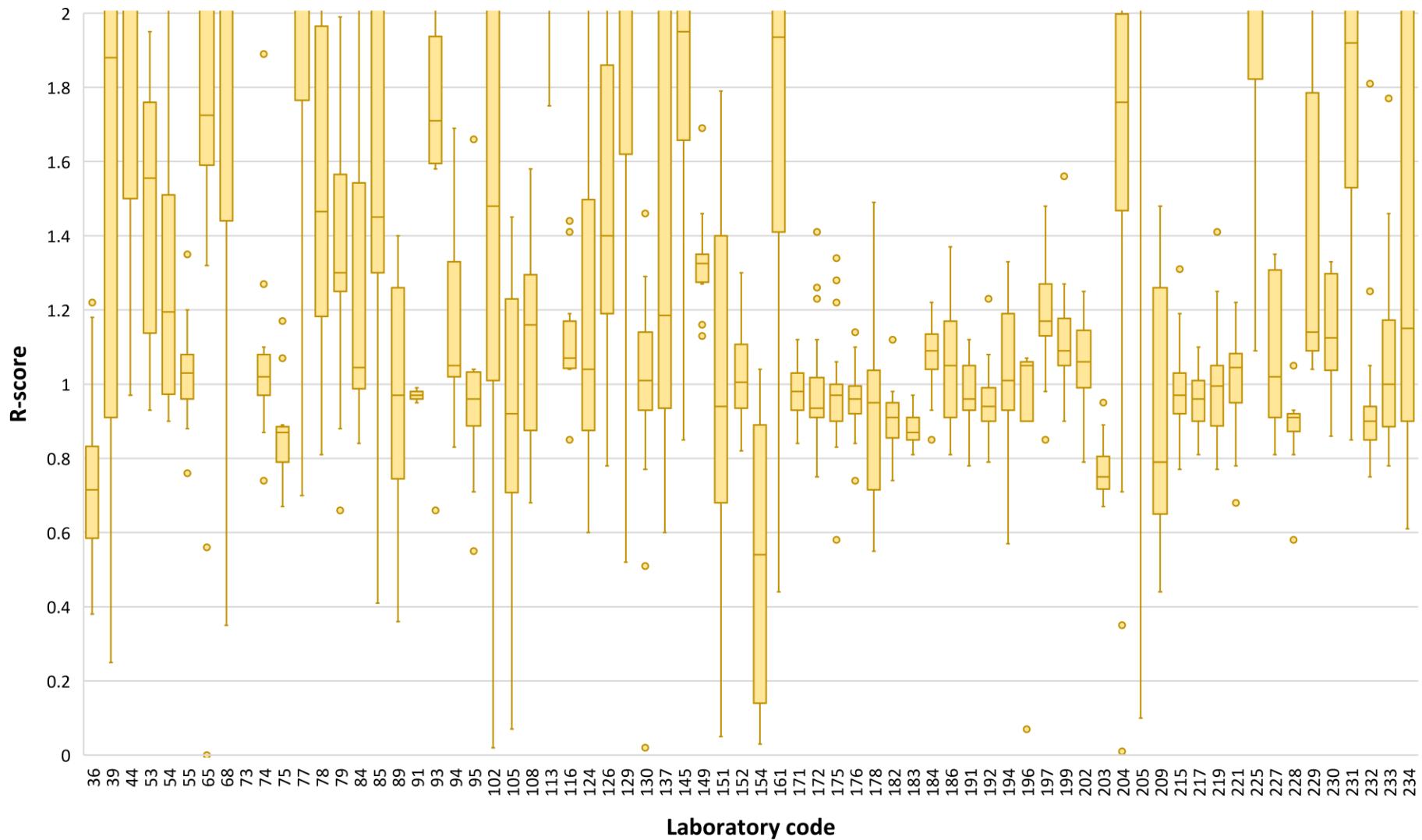


FIG. 173. Box-and-whisker plot of the R-scores for each participant (vertical scale reduced to the range 0÷2).



## REFERENCES

- [1] <http://www.pt-nsil.com/>, last visited 14 May 2021.
- [2] INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, Conformity assessment – General requirements for proficiency testing, ISO/IEC 17043:2010, ISO, Geneva (2008).
- [3] INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, Statistical methods for use in proficiency testing by interlaboratory comparison, ISO 13528:2015, ISO, Geneva (2015).
- [4] Thompson, M. Recent trends in inter-laboratory precision at ppb and sub-ppb concentrations in relation to fitness for purpose criteria in proficiency testing. *Analyst* 2000, 125, 385-386, doi:10.1039/b000282h.
- [5] Currie L.A., “Limits for qualitative detection and quantitative determination – Application to radiochemistry”, *Anal.Chem.* 40 (1968) 586-593.
- [6] Kalmijn W. (2014) Statistics: Rules for Rounding. In: Michalos A.C. (eds) Encyclopedia of Quality of Life and Well-Being Research. Springer, Dordrecht. [https://doi.org/10.1007/978-94-007-0753-5\\_3658](https://doi.org/10.1007/978-94-007-0753-5_3658).



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