

## RFA Ringversuch GeoPT 46A, England - POLC-1, Phosphate Rock

<b>Veranstalter des Ringversuchs:</b>	International Association of Geoanalysts and Geostandards Newsletter - GeoPT 46A
<b>Ringversuchsmaterial:</b>	POLC-1, Phosphate Rock
<b>RV geschlossen:</b>	2020 - 2
<b>Literatur:</b>	Report - GeoPT 46A Proficiency Testing Round 46A (Laborcode CRB = G106)

### Hauptelemente [MA%]

	CRB	RV	1sRV	Z-Score
MgO	1,150	1,100	0,022	1,150
Al <sub>2</sub> O <sub>3</sub>	2,340	2,380	0,040	-0,500
SiO <sub>2</sub>	13,600	13,370	0,181	0,640
P <sub>2</sub> O <sub>5</sub>	26,700	26,580	0,320	0,180
K <sub>2</sub> O	0,110	0,118	0,003	-1,230
CaO	42,000	40,910	0,468	1,160
TiO <sub>2</sub>	0,490	0,490	0,011	0,000
Fe <sub>2</sub> O <sub>3</sub> tot	6,000	5,796	0,089	1,150
L.O.I. *	5,910	5,910	0,090	0,000
F *	1,640	1,990	0,760	-0,230

### Legende

**CRB:** Ergebnisse CRB – **RV:** Ergebnisse Ringversuch -- **1s-RV:** Standardabweichung Ringversuch  
**Z-Score:** Differenz des Messwertes vom Mittelwert des Ringversuchs -- \* Wert nicht zertifiziert



# GeoPT

## Proficiency Testing Programme for Geochemical Laboratories

Organised by the International Association of Geoanalysts (IAG)

### Certificate of Performance



Subscriber: **GeoPT240**  
Round: **GeoPT46A**

Laboratory Code: **G106**

Test Material: **POLC-1**  
Date: **December 2019**

Analyte	Z-Score	Data Quality	Consensus Value	Result Submitted
			g/100g	g/100g
SiO <sub>2</sub>	0.64	2	13.37	13.6
TiO <sub>2</sub>	0.82	2	0.1533	0.16
Al <sub>2</sub> O <sub>3</sub>	0.74	2	2.280	2.34
Fe <sub>2</sub> O <sub>3</sub> T	1.15	2	5.796	6
MnO	0.55	2	1.096	1.12
MgO	1.15	2	1.100	1.15
CaO	1.16	2	40.91	42
K <sub>2</sub> O	-1.23	2	0.1180	0.11
P <sub>2</sub> O <sub>5</sub>	0.18	2	26.58	26.7
LOI	0	2	5.910	5.91
			mg/kg	mg/kg
As	-	2	25.93	
Ba	-1.24	2	219.4	200
Be	-	2	2.030	
Bi	-	2	0.1100	
C(tot)	-	2	12200	
Ce	-3.06	2	932.9	770
Co	-	2	28.88	
Cr	-2.23	2	39.00	31
Cs	-	2	0.2000	
Cu	-	2	21.05	
Dy	-	2	81.32	
Er	-	2	41.21	
Eu	-	2	19.80	
Gd	-	2	103.7	
Hf	-	2	1.387	
Ho	-	2	16.13	
In	-	2	0.02000	

Analyte	Z-Score	Data Quality	Consensus Value	Result Submitted
			mg/kg	mg/kg
La	-2.65	2	468.6	390
Li	-	2	6.506	
Lu	-	2	3.410	
Mo	-	2	1.200	
Nb	-	2	8.000	
Nd	0.12	2	426.7	430
Ni	4.97	2	30.50	45
Pb	7.18	2	77.00	123
Pr	-	2	96.58	
Rb	-	2	4.960	
Sb	-	2	2.982	
Sc	-	2	9.715	
Sm	-	2	88.88	
Sn	-	2	0.5569	
Sr	-1.01	2	734.0	690
Ta	-	2	0.2800	
Tb	-	2	14.35	
Th	-	2	11.10	
Tl	-	2	0.1700	
Tm	-	2	4.879	
U	-	2	29.76	
V	5.67	2	81.04	119
W	-	2	1.280	
Y	-2.65	2	643.0	540
Yb	-	2	25.31	
Zn	1.92	2	33.00	39
Zr	2.32	2	54.85	66

The principles upon which GeoPT z-scores are based are detailed in the full report for this round

- indicates result within acceptable range of z-score limits  $|z| < 2$

- indicates result outside z-score limits  $|z| > 2$  but within the z-score limits  $|z| < \text{or} = 3$

- indicates result outside z-score limits  $|z| > 3$  and likely to require investigation

Consensus values are assigned values unless otherwise indicated

Shaded Consensus values have provisional status

*Peter Webb* . Peter Webb - Administrator of GeoPT on behalf of the International Association of Geoanalysts

# **GeoPT46A — AN INTERNATIONAL PROFICIENCY TEST FOR ANALYTICAL GEOCHEMISTRY LABORATORIES — REPORT ON ROUND 46A (Phosphate rock, POLC-1) / January 2020**

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## **Abstract**

Results are presented for Round 46A of the International Association of Geoanalysts' Proficiency Testing programme for analytical geochemistry laboratories. The test material distributed in this round of *GeoPT* was the Phosphate rock, POLC-1, collected and processed under the direction of Dr Stephen Wilson of the U.S. Geological Survey. In this report, the data contributed by 91 laboratories are listed, together with an assessment of consensus values, consequent *z*-scores and charts to show the distribution of contributed results and the overall performance of participating laboratories.

## **Introduction**

This forty-sixth round of the international proficiency testing programme, *GeoPT*, was conducted in a similar manner to earlier rounds. The programme is designed to be part of the routine quality assurance procedures employed by analytical geochemistry laboratories. The programme is organised by the International Association of Geoanalysts and is conducted in accordance with a published protocol, recently revised (IAG, 2018). The overall aim of the programme is to provide participating laboratories with *z*-score information for their reported measurement results so that each laboratory can decide whether the quality of their data is satisfactory in relation both to their chosen fitness-for-purpose criteria

and to the results submitted by other laboratories contributing to the round. In circumstances where *z*-scores are unsatisfactory, a participating laboratory is encouraged to investigate for unsuspected analytical bias and to take corrective action if it appears to be justified.

**Steering Committee for Round 46A:** P.C. Webb (administrator and results assessor), P.J. Potts (results reviewer), M. Thompson (statistical advisor), C.J.B. Gowing (distribution manager and analytical advisor), S.A. Wilson (provision of POLC-1).

## **Timetable for Round 46A:**

Distribution of sample: September 2019

Results submission deadline: 11th December 2019

Release of report: January 2020

## **Test material details**

**GeoPT46A:** The Phosphate rock test material, POLC-1, is not a common geological material. It has a calcium phosphate matrix, largely comprising the mineral francolite, a carbonate-rich fluorapatite with elevated levels of  $\text{CO}_3^{2-}$  and F and rare earth elements. It was obtained from the Love Hollow phosphorite unit, a sedimentary deposit of Upper Ordovician age, in northern Arkansas and processed under the direction of Dr Stephen Wilson at the U.S. Geological Survey. The test

material was known to be coarser than the norm for the proficiency testing materials that we provide, having proved difficult to crush to a finer grade. Nevertheless, on evaluation for homogeneity by the originator, it was considered suitable for use in this proficiency test.

### Submission of results

For GeoPT46A (POLC-1), a total of 3410 results are listed in Table 1 as submitted by 91 laboratories. Measurement results that were designated by the participating laboratory as data quality 1 (see **Z-score analysis section** below for explanation) are shown in **bold** and those of data quality 2 are shown underlined. Results from all laboratories submitting data were used to assess respective consensus values. It was refreshing to find that no laboratory had reported values of zero in this round, however, it is suspected that six laboratories reported results for either S or F in units of g/100g instead of mg/kg. We must remind analysts reporting results that measurements of both these and those of all trace constituents should be reported in mg/kg. Analysts should be aware that suspected invalid results cannot be altered or removed once they have been submitted and that their corresponding z-scores will be adversely affected by mistakes in reporting.

It was brought to our attention that the coarseness of grain size caused difficulties in dissolution, which might be a reason for underestimated results for some analytes.

### Assigned values and results summary

Following procedures described in earlier rounds, and detailed fully in the GeoPT protocol (IAG, 2018), robust statistical procedures were used to derive consensus values for measurands in this test material: these consensus values being judged to be the best available estimates of the true composition. Values were assigned on the basis that: i) sufficient laboratories had contributed data for estimating a measurand, ii) visual assessment gave confidence that a substantial proportion of the results distribution was symmetrically disposed about the consensus, iii) the ratio of the uncertainty in the location estimate to the target precision was an acceptably small value, and iv) an evaluation of measurement results by procedure – including both

methods of analysis and sample preparation – indicated no significant procedural bias among measurement results from which the consensus was derived. Where these criteria were not fully met, values were credited with 'provisional' rather than 'assigned' status.

These assessments involved examining the distribution of results from barcharts of data contributed for each measurand (as presented in Figures 1 and 2). In addition, when appropriate, a variety of plots permitting discrimination of data by method of analysis and by sample preparation procedure, as developed by Thomas Meisel using the Shiny App (<https://www.shinyapps.io>) and linked to the statistical package 'R', were also examined. This enabled us, when necessary, to refine the selection of consensus values by taking account of data distributions according to analytical procedure.

As detailed in the GeoPT protocol, the consensus values derived from contributed data were provided where appropriate by the Huber robust mean: in this round in 10 instances. Although outliers can be accommodated by this procedure, when a dataset is skewed, it does not provide a satisfactory estimation of the consensus. Consequently, the median was considered a more appropriate robust estimator in 30 cases. For more severely skewed and strongly tailed datasets, a mode can often be more suitable as a means of estimating the location of the consensus. In this round the use of modes as consensus location estimators was preferred in 14 cases, and in 9 of those, distributions were compatible with the conditions outlined above to justify their designation as assigned values. The procedure used to determine modes was most often that described by Thompson (2017) involving the estimation of the mass fraction corresponding to the maximum value of the kernel density distribution for the dataset. Such modes derived by bootstrapping provide robust estimates of consensus locations that represent the most coherent part of a data distribution where data are symmetrically disposed, although the dataset as a whole may be asymmetric.

Table 2 lists assigned and provisional values for 10 major components and 44 trace elements in GeoPT46A (POLC-1). Barcharts for the 54 measurands of

GeoPT46A that were judged to have satisfactory distributions for consensus values to be designated as assigned or provisional values are shown in Figure 1. These are: SiO<sub>2</sub>, TiO<sub>2</sub>\*, Al<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub>T, MnO, MgO, CaO, K<sub>2</sub>O\*, P<sub>2</sub>O<sub>5</sub>, LOI\*, As\*, Ba, Be, Bi, C(tot)\*, Ce, Co, Cr, Cs, Cu\*, Dy, Er, Eu, Gd, Hf, Ho, In\*, La\*, Li, Lu, Mo, Nb, Nd, Ni\*, Pb, Pr, Rb\*, Sb\*, Sc, Sm, Sn\*, Sr, Ta\*, Tb, Th, Tl, Tm, U, V, W, Y, Yb, Zn and Zr\*. Of these, provisional values were credited to the 14 analytes marked '\*'. Instances of provisional status were identified because either: i) a relatively small number of results (<15) contributed to the consensus; or ii) the results were unduly dispersed in relation to the target value; or iii) the distribution of results was significantly skewed: thus increasing the uncertainty in the identification of the consensus.

Bar charts for the 15 analytes: Fe(II)O, Na<sub>2</sub>O, H<sub>2</sub>O<sup>+</sup>, CO<sub>2</sub>, Ag, B, C(org), Cd, Cl, F, Ga, Ge, S, Se and Te are plotted in Figure 2 for information only, as the data were either insufficient in number, or the distribution was too highly skewed or too variable for the reliable determination of a consensus for the estimation of z-scores.

There was an expectation that results could be adversely affected on account of: i) the matrix being unfamiliar to many analysts; ii) the mass fractions of many analytes being significantly in excess of those routinely encountered with the consequent possibility of unexpected interferences that would not be accounted for; and iii) mass fractions of some analytes being at or beyond the limits of routine calibrations. However, an assessment of the distribution of submitted results indicates that in general these concerns did not significantly affect the quality of the data, other than possibly causing, in some cases, a higher than usual dispersion of data. Indeed, a substantial number of datasets in this round were normally disposed, showing remarkable symmetry without excessive dispersion of the majority of the data, particularly for Al<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub>T, MnO, Dy, Er, Eu, Ho, Lu, Sm, Tb, Tm, U and Yb. A small amount of asymmetry with some high or low tailing of data but without excessive dispersion was noted for CaO, Be, Ho, Li, Mo, Pb, Pr, Th, Tl, V and U. However, there were a number of constituents for which

low tailing distributions were noted, most markedly for Hf and Zr, but also present to varying extents for CaO, P<sub>2</sub>O<sub>5</sub>, Ba, C(tot), Ce, La, Nb, Ni, Pb, Sb, V, Y and Zn. For Zr and Hf the majority of these low values was reported by laboratories using acid digestion prior to ICP-MS or ICP-AES measurement. It is suspected that digestion recoveries were incomplete for these analytes, because they are commonly hosted by zircons which are refractory and susceptible to incomplete dissolution, as recognised by Potts et al (2015). However, there are also instances where XRF powder pellet results appear to be biased towards lower values compared to results on fusion discs. High tails were noted for MgO, Bi, Cd, Cr, Cs, Cu, Mo, Nb, Ni, Rb, Sc, Sn, Th and W. A significant proportion of measurements contributing to these high tails originate as XRF values (e.g. Bi, Cs, Rb, Sc, W) and sometimes ICP-AES values being reported at mass fractions that are close to, and in some cases below, a realistic detection limit for the technique.

For Na<sub>2</sub>O, the low mass fraction present in the test material was almost certainly the reason for a high dispersion of data which extended well beyond our fitness-for-purpose targets. As a consequence, although values reported for a number of laboratories coincided, it was not possible to propose with any confidence a consensus value for the purpose of calculating z-scores. In some sets of results stepped distributions were apparent where insufficient decimal places were quoted in much of the contributed data to obtain a smooth distribution. This applies particularly to the POLC-1 results for TiO<sub>2</sub> and K<sub>2</sub>O.

### Z-score analysis

As in previous rounds, laboratories were invited to choose one of two performance standards against which their analytical results would be judged:

**Data quality 1** for laboratories working to a 'pure geochemistry' standard of performance, where analytical results are designed for geochemical research and where care is taken to provide data of high precision and accuracy, sometimes at the expense of a reduced sample throughput rate. For GeoPT46A, 1457 results of data quality 1 were submitted.

**Data quality 2** for laboratories working to an 'applied geochemistry' standard of performance, where, although precision and accuracy are still important, the main objective is to provide results on large numbers of samples collected, for example, as part of geochemical mapping projects or geochemical exploration programmes. For GeoPT46A, 1953 results of data quality 2 were submitted.

The target standard deviation ( $H_a$ ) for each measurand assessed was calculated from a modified form of the Horwitz function as follows:

$$H_a = k \cdot X_a^{0.8495}$$

Where  $X_a$  is the mass fraction of the element; the factor  $k = 0.01$  for pure geochemistry laboratories and  $k = 0.02$  for applied geochemistry laboratories.

Z-scores were calculated for each elemental measurement submitted by each laboratory from:

$$z = [X - X_a] / H_a$$

Where  $X$  is the contributed measurement result,  $X_a$  is the assigned value and  $H_a$  is the target standard deviation (all as mass fractions). Z-scores for results contributed to GeoPT46A are listed in Table 3. Results designated as data quality 1 are shown in bold: results of data quality 2 are shown underlined. Z-scores derived from provisional values of measurands are shown in italics.

Participating laboratories are invited to assess their performance using the following criteria:–

Z-score results in the range  $-2 < z < 2$  are considered to be 'satisfactory' (in the sense that no action is called for by the participant). If the z-score for an element falls outside this range, especially if it is outside the range  $-3 < z < 3$ , laboratories are advised to examine their procedures, and if necessary, take action to ensure that determinations are not subject to unsuspected analytical bias.

### Overall performance

A summary of the overall performance of individual laboratories for this round is plotted in multiple z-score charts in Figure 3. In these charts, the z-score performance for each element is distinguished by symbols that make it easy to identify whether the results

were satisfactory or gave z-scores that exceeded the action limits. This chart is designed to help individual laboratories judge their overall performance in this proficiency testing round. Participants should always review their z-scores in accordance with their own fitness-for-purpose criteria.

### Participation in future rounds

The benefit from proficiency testing arises from regular participation and laboratories are invited to contribute to Round 47, the test sample for which will be distributed during March 2020.

### Acknowledgements

The authors once again thank Cynthia Turner and Andrea Mills (BGS) for much-valued assistance in distributing this sample and Thomas Meisel for development of a procedure using the Shiny App software which has greatly assisted the investigation of data according to analytical procedure and facilitated analysis of datasets involving modes derived according to Thompson (2017).

### References

- IAG (2018)** Protocol for the operation of the GeoPT Proficiency testing scheme. International Association of Geoanalysts (Keyworth, UK), 18pp.  
<http://www.geoanalyst.org/wp-content/uploads/2018/06/GeoPT-revised-protocol-2018.pdf>.
- Potts P.J., Webb P.C. and Thompson M. (2015)** Bias in the determination of Zr, Y and rare earth element concentrations in selected silicate rocks by ICP-MS when using some routine acid dissolution procedures: Evidence from the GeoPT proficiency testing programme. *Geostandards and Geoanalytical Research*, 39, 403–416.
- Thompson, M. (2017)** On the role of the mode as a location parameter for the results of proficiency tests in chemical measurement. *Anal. Methods*, 9, p.5534-5540.

## ADDENDUM

### — AN IMPORTANT NOTICE TO ANALYSTS

#### Explicit advice to analysts regarding reporting of procedures involving ignition and fusion:

We continue to request that analysts reporting measurement results for procedures involving fusion, sintering or ignition, particularly LOI determinations, specify the temperature used and where appropriate, the end-point criterion, e.g. the duration of ignition. This information should be supplied in the descriptions of your relevant **Procedures**, as **Additional Details**.

Note that a large number of laboratories are listing their procedure for determining LOI as the same as that employed for major elements, rather than providing separate, specific details. It is important to provide information that is appropriate for every analyte.

In addition, it would help if details of gravimetric procedures were included under **Analytical Technique details** rather than under **Sample Preparation details**.

For gravimetric analysis, other than drying, which should

in any case be carried out according to our instructions, there is no other sample preparation involved.

#### References of general relevance

**Potts P.J., Webb, P.C. and Thompson M. (2019)** The GeoPT proficiency testing programme as a scheme for the certification of geological reference materials. *Geostandards and Geoanalytical Research*, **43**, 409–418.

**Webb, P.C., Potts P.J., Thompson M., Wilson, S.A. and Gowing, C.J.B. (2019)** The long-term robustness and stability of consensus values as composition location estimators for a typical geochemical test material in the GeoPT proficiency testing programme. *Geostandards and Geoanalytical Research*, **43**, 397–408.

**Potts P.J. and Webb, P.C (2019)** An Evaluation of Methods for Assessing the Competence of Laboratories Based on Performance in the GeoPT Proficiency Testing Scheme. *Geostandards and Geoanalytical Research*, **43**, 217–229.

## Appendix 1

Publication status of proficiency testing reports. Reports of previous rounds are available for download from the IAG website (<http://www.geoanalyst.org/>).

#### **GeoPT1**

Thompson M., Potts P.J., Kane J.S. and Webb P.C. (1996) GeoPT1. International proficiency test for analytical geochemistry laboratories - Report on round 1. *Geostandards Newsletter: The Journal of Geostandards and Geoanalysis*, **20**, 295-325.

#### **GeoPT2**

Thompson M., Potts P.J., Kane J.S., Webb P.C. and Watson, J.S. (1998) GeoPT2. International proficiency test for analytical geochemistry laboratories - Report on round 2. *Geostandards Newsletter: The Journal of Geostandards and Geoanalysis*, **22** 127-156.

#### **GeoPT3**

Thompson M., Potts P.J., Kane J.S. and Chappell B.W. (1999a) GeoPT3. International proficiency test for analytical geochemistry laboratories - Report on round 3. *Geostandards Newsletter: The Journal of Geostandards and Geoanalysis*, **23**, 87-121.

#### **GeoPT4**

Thompson M., Potts P.J., Kane J.S., Webb P.C. and Watson J.S. (1999b) GeoPT4. International proficiency test for analytical geochemistry laboratories - Report on round 4. Published in the electronic version of *Geostandards Newsletter: The Journal of Geostandards and Geoanalysis* (Summer 2000).

#### **GeoPT5**

Thompson M., Potts P.J., Kane J.S., and Wilson S. (1999c) GeoPT5. International proficiency test for analytical geochemistry laboratories - Report on round 5. Published in the electronic version of *Geostandards Newsletter: The Journal of Geostandards and Geoanalysis* (Summer 2000).

#### **GeoPT6**

Potts P.J., Thompson M., Kane J.S., Webb P.C. and Carignan J. (2000) GEOPT6 - an international proficiency test for analytical geochemistry laboratories - report on round 6 (OU-3: Nanhon microgranite) and 6A (CAL-S: CRPG limestone). International Association of Geoanalysts: Unpublished report.

#### **GeoPT7**

Potts P.J., Thompson M., Kane J.S., and Petrov L.L. (2000) GEOPT7 - an international proficiency test for analytical geochemistry laboratories - report on round 7 (GBPG-1 Garnet-biotite plagiogneiss). International Association of Geoanalysts: Unpublished report.

#### **GeoPT8**

Potts P.J., Thompson M., Kane J.S., Webb, P.C. and Watson J.S. (2000) GEOPT8 - an international proficiency test for analytical geochemistry laboratories - report on round 8 / February 2001 (OU-4 Penmaenmawr microdiorite). International Association of Geoanalysts: Unpublished report.

#### **GeoPT9**

Potts P.J., Thompson M., Webb, P.C. and Watson J.S. (2001) GEOPT9 - an international proficiency test for analytical geochemistry laboratories - report on round 9 / July 2001 (OU-6 Penrhyn slate). International Association of Geoanalysts: Unpublished report.

**GeoPT10**

Potts P.J., Thompson M., Webb, P.C., Watson J.S. and Wang Yimin (2001)  
GeoPT10 - an international proficiency test for analytical geochemistry laboratories - report on round 10 / December 2001 (CH-1 Marine sediment). International Association of Geoanalysts: Unpublished report.

**GeoPT11**

Potts P.J., Thompson M., Chenery S.R., Webb, P.C. and Watson J.S. (2002)  
GeoPT11 - an international proficiency test for analytical geochemistry laboratories - report on round 11 / July 2002 (OU-5 Leaton dolerite). International Association of Geoanalysts: Unpublished report.

**GeoPT12**

Potts P.J., Thompson M., Chenery S.R., Webb, P.C. and Batjargal B. (2003)  
GeoPT12 - an international proficiency test for analytical geochemistry laboratories - report on round 12 / January 2003 (GAS Serpentinite). International Association of Geoanalysts: Unpublished report.

**GeoPT13**

Potts P.J., Thompson M., Chenery S.R., Webb, P.C. and Kaspar H.U. (2003)  
GeoPT13 - an international proficiency test for analytical geochemistry laboratories - report on round 13 / July 2003 (Köln Loess). International Association of Geoanalysts: Unpublished report.

**GeoPT14**

Potts P.J., Thompson M., Chenery S.R., Webb, P.C. and B. Batjargal (2004)  
GeoPT14 - an international proficiency test for analytical geochemistry laboratories - report on round 14 / January 2004 (OShBO - alkaline granite). International Association of Geoanalysts: Unpublished report.

**GeoPT15**

Potts P.J., Thompson M., Chenery S.R., Webb, P.C. and Wang Yimin (2004)  
GeoPT15 - an international proficiency test for analytical geochemistry laboratories - report on round 15 / June 2004 (Ocean floor sediment MSAN). International Association of Geoanalysts: Unpublished report.

**GeoPT16**

Potts P.J., Thompson M., Webb, P.C. and S.Wilson (2005)  
GeoPT16 - an international proficiency test for analytical geochemistry laboratories - report on round 16 / February 2005 (Nevada basalt, BNV-1). International Association of Geoanalysts: Unpublished report.

**GeoPT17**

Potts P.J., Thompson M., Webb, P.C. and J. Nicholas Walsh (2005)  
GeoPT17 - an international proficiency test for analytical geochemistry laboratories - report on round 17 / July 2005 (Calcareous sandstone, OU-8). International Association of Geoanalysts: Unpublished report.

**GeoPT18**

Webb, P.C., Thompson M., Potts P.J. and L. Paul Bedard (2006)  
GeoPT18 - an international proficiency test for analytical geochemistry laboratories - report on round 18 / Jan 2006 (Quartz Diorite, KPT-1). International Association of Geoanalysts: Unpublished report.

**GeoPT19**

Webb, P.C., Thompson M., Potts P.J. and B. Batjargal (2006)  
GeoPT19 - an international proficiency test for analytical geochemistry laboratories - report on round 19 / July 2006 (Gabbro, MGR-N). International Association of Geoanalysts: Unpublished report.

**GeoPT20**

Webb, P.C., Thompson M., Potts P.J. and M. Burnham (2007)  
GeoPT20 - an international proficiency test for analytical geochemistry laboratories - report on round 20 / Jan 2007 (Ultramafic rock, OPY-1). International Association of Geoanalysts: Unpublished report.

**GeoPT21**

Webb, P.C., Thompson M., Potts P.J. and B. Batjargal (2007)  
GeoPT21 - an international proficiency test for analytical geochemistry laboratories - report on round 21 / July 2007 (Granite, MGT-1). International Association of Geoanalysts: Unpublished report.

**GeoPT22**

Webb, P.C., Thompson, M., Potts, P.J. and Batjargal, B. (2008)  
GeoPT22 - an international proficiency test for analytical geochemistry laboratories - report on round 22 / January 2008 (Basalt, MBL-1). International Association of Geoanalysts: Unpublished report.

**GeoPT23**

Webb, P.C., Thompson, M., Potts, P.J., Watson, J.S. and Kriete, C. (2008)  
GeoPT23 - an international proficiency test for analytical geochemistry laboratories - report on round 23 / September 2008 (Separation Lake pegmatite, OU-9) and 23A (Manganese nodule, FeMn-1). International Association of Geoanalysts: Unpublished report.

**GeoPT24**

Webb, P.C., Thompson, M., Potts, P.J. and Watson, J.S. (2009)  
GeoPT24 - an international proficiency test for analytical geochemistry laboratories - report on round 24 / January 2009 (Longmyndian greywacke, OU-10). International Association of Geoanalysts: Unpublished report.

**GeoPT25**

Webb, P.C., Thompson, M., Potts, P.J. and Enzweiler, J. (2009)  
GeoPT25 - an international proficiency test for analytical geochemistry laboratories - report on round 25 / July 2009 (Basalt, HTP-1). International Association of Geoanalysts: Unpublished report.

**GeoPT26**

Webb, P.C., Thompson, M., Potts, P.J. and Loubser, M. (2010)  
GeoPT26 - an international proficiency test for analytical geochemistry laboratories - report on round 26 / January 2010 (Ordinary Portland cement, OPC-1). International Association of Geoanalysts: Unpublished report.

**GeoPT27**

Webb, P.C., Thompson, M., Potts, P.J. and Batjargal, B. (2010)  
GeoPT27 - an international proficiency test for analytical geochemistry laboratories - report on round 27 / July 2010 (Andesite, MGL-AND). International Association of Geoanalysts: Unpublished report.

**GeoPT28**

Webb, P.C., Thompson, M., Potts, P.J. and Wilson, S. (2011)  
GeoPT28 - an international proficiency test for analytical geochemistry laboratories - report on round 28 / January 2011 (Shale, SBC-1). International Association of Geoanalysts: Unpublished report.

**GeoPT29**

Webb, P.C., Thompson, M., Potts, P.J. and Wilson, S. (2011)  
GeoPT29 - an international proficiency test for analytical geochemistry laboratories - report on round 29 / July 2011 (Nephelinite, NKT-1). International Association of Geoanalysts: Unpublished report.

**GeoPT30**

Webb, P.C., Thompson, M., Potts, P.J., Long, D. and Batjargal, B. (2012)  
GeoPT30 - an international proficiency test for analytical geochemistry laboratories - report on round 30 / January 2012 (Syenite, CG-2) and 30A (Limestone, ML-2). International Association of Geoanalysts: Unpublished report.

**GeoPT31**

Webb, P.C., Thompson, M., Potts, P.J. and Wilson, S. (2012)  
GeoPT31 - an international proficiency test for analytical geochemistry laboratories - report on round 31 / July 2012 (Modified river sediment, SdAR-1). International Association of Geoanalysts: Unpublished report.

**GeoPT32**

Webb, P.C., Thompson, M., Potts, P.J. and Webber, E. (2013)  
GeoPT32 - an international proficiency test for analytical geochemistry laboratories - report on round 32 / January 2013 (Woodstock Basalt, WG-1). International Association of Geoanalysts: Unpublished report.



**GeoPT33**

Webb, P.C., Thompson, M., Potts, P.J., Prusisz, B., and Young, K. (2013)

GeoPT33 - an international proficiency test for analytical geochemistry laboratories - report on round 33 / July-August 2013 (Ball Clay, DBC-1). International Association of Geoanalysts: Unpublished report.

**GeoPT34**

Webb, P.C., Thompson, M., Potts, P.J and Wilson, S. (2014)

GeoPT34 - an international proficiency test for analytical geochemistry laboratories - report on round 34 (Granite, GRI-1) / January 2014. International Association of Geoanalysts: Unpublished report.

**GeoPT35**

Webb, P.C., Thompson, M., Potts, P.J and Wilson, S. (2014)

GeoPT35 - an international proficiency test for analytical geochemistry laboratories - report on round 35 (Tonalite, TLM-1) / August 2014. International Association of Geoanalysts: Unpublished report.

**GeoPT35A**

Webb, P.C., Thompson, M., Potts, P.J and Wilson, S. (2014)

GeoPT35A - an international proficiency test for analytical geochemistry laboratories - report on round 35A (Metalliferous sediment, SdAR-H1) / August 2014. International Association of Geoanalysts: Unpublished report.

**GeoPT36**

Webb, P.C., Thompson, M., Potts, P.J and Wilson, S. (2015)

GeoPT36 - an international proficiency test for analytical geochemistry laboratories - report on round 36 (Gabbro, GSM-1) / January 2015. International Association of Geoanalysts: Unpublished report.

**GeoPT36A**

Webb, P.C., Thompson, M., Potts, P.J and Wilson, S. (2015)

GeoPT36A - an international proficiency test for analytical geochemistry laboratories - report on round 36A (Metal-rich sediment, SdAR-M2) / January 2015. International Association of Geoanalysts: Unpublished report.

**GeoPT37**

Webb, P.C., Thompson, M., Potts, P.J, Gowing, C.J.B. and Burnham, M. (2015)

GeoPT37 - an international proficiency test for analytical geochemistry laboratories - report on round 37 (Rhyolite, ORPT-1) / July 2015. International Association of Geoanalysts: Unpublished report.

**GeoPT37A**

Webb, P.C., Thompson, M., Potts, P.J, Gowing, C.J.B. and Wilson, S. (2015)

GeoPT37A - an international proficiency test for analytical geochemistry laboratories - report on round 37A (Blended sediment, SdAR-L2) / July 2015. International Association of Geoanalysts: Unpublished report.

**GeoPT38**

Webb, P.C., Thompson, M., Potts, P.J, Gowing, C.J.B. and Wilson, S.A. (2016)

GeoPT38 - an international proficiency test for analytical geochemistry laboratories - report on round 38 (Gabbro, OU-7) / January 2016. International Association of Geoanalysts: Unpublished report.

**GeoPT38A**

Webb, P.C., Thompson, M., Potts, P.J, Gowing, C.J.B. and Meisel, T. (2016)

GeoPT38A - an international proficiency test for analytical geochemistry laboratories – special report on round 38A (Modified harzburgite, HARZ01) / June 2016. International Association of Geoanalysts: Unpublished report.

**GeoPT39**

Webb, P.C., Thompson, M., Potts, P.J, Gowing, C.J.B. and Wilson, S.A. (2016)

GeoPT39 - an international proficiency test for analytical geochemistry laboratories - report on round 39 (Syenite, SyMP-1) / July 2016. International Association of Geoanalysts: Unpublished report.

**GeoPT39A**

Webb, P.C., Thompson, M., Potts, P.J and Gowing, C.J.B. (2016)

GeoPT39A - an international proficiency test for analytical geochemistry laboratories - report on round 39A (Nepheline syenite, MNS-1) / July 2016. International Association of Geoanalysts: Unpublished report.

**GeoPT40**

Webb, P.C., Thompson, M., Potts, P.J, Gowing, C.J.B. and Wilson, S.A. (2017)

GeoPT40 - an international proficiency test for analytical geochemistry laboratories - report on round 40 (Silty marine shale, ShWYO-1) / January 2017. International Association of Geoanalysts: Unpublished report.

**GeoPT40A**

Webb, P.C., Thompson, M., Potts, P.J, Gowing, C.J.B. and Wilson, S.A. (2017)

GeoPT40A - an international proficiency test for analytical geochemistry laboratories - report on round 40A (Calcareous organic-rich shale, ShTX-1) / January 2017. International Association of Geoanalysts: Unpublished report.

**GeoPT41**

Webb, P.C., Thompson, M., Potts, P.J, Gowing, C.J.B. and Wilson, S.A. (2017)

GeoPT41 - an international proficiency test for analytical geochemistry laboratories - report on round 41 (Andesite, ORA-1) / July 2017. International Association of Geoanalysts: Unpublished report.

**GeoPT41A**

Webb, P.C., Thompson, M., Potts, P.J, Gowing, C.J.B. and Wilson, S.A. (2017)

GeoPT41A - an international proficiency test for analytical geochemistry laboratories - report on round 41A (Mineralized stream sediment, SSCO-1) / July 2017. International Association of Geoanalysts: Unpublished report.

**GeoPT42**

Webb, P.C., Thompson, M., Potts, P.J., Gowing, C.J.B. and Burnham, M. (2018)

GeoPT42 – an international proficiency test for analytical geochemistry laboratories – report on round 42 (Queenston shale, QS-1) / January 2018. International Association of Geoanalysts: Unpublished report.

**GeoPT43**

Webb, P.C., Potts, P.J., Thompson, M. and Gowing, C.J.B. (2018)

GeoPT43 – an international proficiency test for analytical geochemistry laboratories – report on round 43 (Dolerite, ADS-1) / July 2018. International Association of Geoanalysts: Unpublished report.

**GeoPT44**

Webb, P.C., Potts, P.J., Thompson, M., Gowing, C.J.B. (2019)

GeoPT44 – an international proficiency test for analytical geochemistry laboratories – report on round 44 (Calcareous shale, ShCX-1) / January 2019. International Association of Geoanalysts: Unpublished report.

**GeoPT44A**

Webb, P.C., Potts, P.J., Thompson, M. Gowing, C.J.B. and Wilson, S.A. (2019)

GeoPT44A – an international proficiency test for analytical geochemistry laboratories – report on round 44A (Calcareous mudrock, CM-1) / January 2019. International Association of Geoanalysts: Unpublished report.

**GeoPT45**

Webb, P.C., Potts, P.J., Thompson, M. Gowing, C.J.B. and Wilson, S.A. (2019)

GeoPT45 – an international proficiency test for analytical geochemistry laboratories – report on round 45 (Silicified siltstone, GONV-1) / July 2019. International Association of Geoanalysts: Unpublished report.

















Table 2 - GeoPT46A Consensus values and statistical summary for Phosphate rock, POLC-1.

	Consensus Value	Uncertainty of consensus value	Horwitz Target Value	Uncertainty/Target	Number of reported results	Robust Mean of results	Robust SD of results	Median of results	Status of consensus value	Type of consensus value
	$X_a$	$s_{dm}$	$H_a$	$s_{dm}/H_a$	$n$					
	g 100g <sup>-1</sup>	g 100g <sup>-1</sup>	g 100g <sup>-1</sup>			g 100g <sup>-1</sup>	g 100g <sup>-1</sup>	g 100g <sup>-1</sup>		
SiO2	13.37	0.03954	0.181	0.2184	81	13.38	0.5403	13.37	Assigned	Median
TiO2	0.1533	0.001676	0.004066	0.4123	79	0.1533	0.0149	0.15	Provisional	Robust Mean
Al2O3	2.28	0.009764	0.04028	0.2424	83	2.294	0.1123	2.28	Assigned	Median
Fe2O3T	5.796	0.02006	0.08898	0.2254	82	5.809	0.1991	5.796	Assigned	Median
MnO	1.096	0.007031	0.02162	0.3251	78	1.096	0.06209	1.095	Assigned	Robust Mean
MgO	1.1	0.00605	0.02169	0.279	80	1.116	0.05936	1.1	Assigned	Mode
CaO	40.91	0.1067	0.468	0.2279	82	40.81	1.107	40.91	Assigned	Median
K2O	0.118	0.001476	0.003255	0.4535	80	0.118	0.0132	0.12	Provisional	Robust Mean
P2O5	26.58	0.08224	0.3245	0.2534	79	26.54	0.9225	26.58	Assigned	Median
LOI	5.91	0.04567	0.09047	0.5048	74	5.887	0.3778	5.91	Provisional	Median
	mg kg <sup>-1</sup>	mg kg <sup>-1</sup>	mg kg <sup>-1</sup>			mg kg <sup>-1</sup>	mg kg <sup>-1</sup>	mg kg <sup>-1</sup>		
As	25.93	0.7719	1.271	0.6074	47	25.93	5.292	26.14	Provisional	Robust Mean
Ba	219.4	2.855	7.795	0.3663	74	219.4	24.56	218.3	Assigned	Robust Mean
Be	2.03	0.03566	0.146	0.2443	41	2.02	0.2174	2.03	Assigned	Median
Bi	0.11	0.00323	0.01226	0.2634	22	0.1225	0.02594	0.116	Assigned	Mode
C(tot)	12200	102	236.8	0.4309	19	11910	769.1	12200	Provisional	Median
Ce	932.9	12.5	26.66	0.4687	69	932.9	103.8	933.5	Assigned	Robust Mean
Co	28.88	0.4929	1.392	0.354	62	28.88	3.881	28.9	Assigned	Robust Mean
Cr	39	0.746	1.797	0.4151	68	40.01	6.447	39.5	Assigned	Mode
Cs	0.2	0.004631	0.02038	0.2272	41	0.22	0.05245	0.2	Assigned	Median
Cu	21.05	0.39	1.064	0.3664	71	22.59	5.629	21.4	Provisional	Mode
Dy	81.32	1.05	3.355	0.313	53	82.29	6.44	82.1	Assigned	Mode
Er	41.21	0.4541	1.883	0.2411	51	41.54	3.237	41.21	Assigned	Median
Eu	19.8	0.2125	1.011	0.2102	49	19.91	1.411	19.8	Assigned	Median
Gd	103.7	1.464	4.125	0.3549	52	104.2	10.41	103.7	Assigned	Median
Hf	1.387	0.05533	0.1056	0.5239	37	1.353	0.5518	1.387	Assigned	Median
Ho	16.13	0.174	0.8487	0.205	50	16.21	1.155	16.13	Assigned	Median
In	0.02	0.0007863	0.002882	0.2728	8	0.01992	0.00279	0.02	Provisional	Median
La	468.6	5.658	14.85	0.3809	69	465.6	55.55	468.6	Provisional	Median
Li	6.506	0.1388	0.3926	0.3535	32	6.506	0.7851	6.48	Assigned	Robust Mean
Lu	3.41	0.03076	0.2268	0.1357	50	3.41	0.2175	3.41	Assigned	Robust Mean
Mo	1.2	0.03165	0.09338	0.339	43	1.236	0.265	1.2	Assigned	Median
Nb	8	0.1765	0.4679	0.3771	51	7.862	1.768	8	Assigned	Median
Nd	426.6	3.994	13.72	0.2912	64	426.1	36.28	426.6	Assigned	Median
Ni	30.5	0.452	1.459	0.3099	71	33.02	8.162	31.08	Provisional	Mode
Pb	77	0.7731	3.203	0.2414	68	76.24	8.881	77	Assigned	Median
Pr	96.58	1.23	3.883	0.3168	53	97.75	8.281	96.8	Assigned	Mode
Rb	4.96	0.135	0.3117	0.433	61	5.541	1.166	5.487	Provisional	Mode
Sb	2.982	0.1604	0.2023	0.7928	38	2.898	0.904	2.982	Provisional	Median
Sc	9.715	0.135	0.5519	0.2446	51	10.25	1.491	9.832	Assigned	Mode
Sm	88.88	0.9002	3.618	0.2488	57	89.13	7.431	88.88	Assigned	Median
Sn	0.5569	0.02654	0.04865	0.5456	26	0.6217	0.1681	0.6	Provisional	Mode
Sr	734	8.13	21.75	0.3738	74	728.6	53.13	732.7	Assigned	Mode
Ta	0.28	0.01222	0.02712	0.4506	32	0.2715	0.09548	0.28	Provisional	Median
Tb	14.35	0.1483	0.7687	0.1929	49	14.45	1.068	14.35	Assigned	Median
Th	11.1	0.134	0.618	0.2168	60	11.23	1.309	11.1	Assigned	Median
Tl	0.17	0.002663	0.01775	0.15	31	0.1737	0.028	0.17	Assigned	Median
Tm	4.879	0.05363	0.3074	0.1744	48	4.879	0.3715	4.89	Assigned	Robust Mean
U	29.76	0.324	1.429	0.2268	63	29.94	3.022	29.9	Assigned	Mode
V	81.03	0.8275	3.345	0.2474	70	81.35	9.215	81.03	Assigned	Median
W	1.28	0.0556	0.09864	0.5636	33	1.573	0.5758	1.358	Assigned	Mode
Y	643	5.532	19.43	0.2847	73	641.6	54.73	643	Assigned	Median
Yb	25.3	0.2239	1.245	0.1799	56	25.5	2.07	25.3	Assigned	Median
Zn	33	0.5525	1.559	0.3543	71	32.65	5.107	33	Assigned	Median
Zr	54.85	1.65	2.401	0.6871	66	52.27	17.11	54	Provisional	Mode

Table 3 - GeoPT46A Z-scores for Phosphate rock, POLC-1. 11/12/2019

Lab Code	G2	G4	G5	G6	G9	G10	G11	G12	G13	G14	G16	G17	G18
SiO2	-0.72	0.41	0.00	-1.09	-1.30	-0.14	0.11	2.85	-1.30	1.49	6.60	1.68	1.69
TiO2	*	-1.64	0.45	42.22	-1.64	-1.51	-0.41	174.20	-0.04	1.64	-9.63	14.22	-4.10
Al2O3	-4.22	-0.37	0.12	1.49	-0.37	0.09	0.37	9.19	-0.12	-1.74	10.92	4.79	0.74
Fe2O3T	-1.19	-0.03	0.42	*	-1.66	-0.68	0.03	-5.59	-0.71	3.42	2.22	25.04	0.08
MnO	-0.29	2.40	-0.42	*	*	-0.33	0.55	-1.07	0.32	8.04	1.24	*	-0.37
MgO	-6.46	0.23	-0.23	*	-0.69	-0.55	-0.92	*	-1.38	2.77	2.31	1.29	-0.46
CaO	0.68	0.33	0.13	-83.82	0.63	0.00	-0.43	-1.93	-0.44	4.53	-3.62	-6.14	-1.31
K2O	-2.45	0.31	-2.76	-11.67	0.31	0.00	0.31	-6.08	0.46	0.62	14.14	-2.30	-1.23
P2O5	-1.02	0.59	-0.34	*	0.80	0.18	-4.11	-2.13	-0.28	-4.81	-2.96	0.32	3.88
LOI	16.64	-1.82	-2.60	-55.16	0.17	-0.64	-2.71	*	0.72	5.75	2.49	1.81	2.04
As	-2.31	*	*	*	*	-0.37	*	-5.44	8.25	-0.73	*	6.92	-2.33
Ba	0.59	*	*	*	*	3.36	44.49	8.38	0.43	3.03	*	-6.30	0.87
Be	*	*	*	*	*	-0.69	*	*	0.62	*	*	-2.73	*
Bi	*	*	*	*	*	-0.41	*	142.28	0.65	*	*	*	*
C(tot)	*	*	*	*	*	0.63	*	*	0.42	*	*	*	*
Ce	-4.42	*	*	3.02	*	-1.60	*	15.14	2.01	-0.71	*	-4.23	*
Co	-1.49	*	*	*	*	0.47	*	*	-0.10	*	*	-1.92	1.84
Cr	1.84	*	*	*	*	0.28	*	0.83	0.14	-1.11	*	-1.87	0.56
Cs	1437.62	*	*	*	*	0.00	*	*	*	2639.72	*	*	*
Cu	11.13	*	*	*	*	0.89	*	15.34	0.21	37.53	*	*	1.86
Dy	*	*	*	0.23	*	-1.28	*	9.19	0.92	*	*	-1.94	*
Er	*	*	*	-0.32	*	-0.82	*	*	1.41	*	*	-1.20	*
Eu	*	*	*	1.93	*	-1.12	*	*	0.74	*	*	-1.74	*
Gd	*	*	*	5.53	*	-1.23	*	15.43	1.25	*	*	-1.34	*
Hf	*	*	*	*	*	1.86	*	*	*	*	*	*	*
Ho	*	*	*	0.03	*	-0.88	*	*	0.87	*	*	-1.46	*
In	*	*	*	*	*	*	*	*	*	*	*	*	*
La	-2.01	*	*	3.53	*	-1.64	*	10.89	1.49	2.32	*	-3.08	*
Li	*	*	*	*	*	*	*	*	1.05	*	*	*	*
Lu	*	*	*	0.04	*	-1.08	*	*	0.51	*	*	-0.63	*
Mo	3.21	*	*	*	*	0.21	*	*	0.21	115.65	*	13.34	*
Nb	7.91	*	*	*	*	-0.84	*	3.10	-2.64	0.00	*	*	*
Nd	-2.45	*	*	5.13	*	-1.78	*	15.21	1.91	*	*	-3.56	*
Ni	6.86	*	*	*	*	-0.07	*	47.82	0.34	13.37	*	-4.50	-2.23
Pb	-1.75	*	*	*	*	0.30	*	-0.22	1.84	-0.31	*	5.09	-0.47
Pr	*	*	*	0.88	*	-1.37	*	4.05	1.21	*	*	-2.18	*
Rb	0.45	*	*	*	*	0.39	*	11.61	1.14	12.96	*	-2.12	*
Sb	6.51	*	*	*	*	0.79	*	*	-2.23	*	*	*	*
Sc	30.78	*	*	*	*	-0.65	*	*	-1.05	42.19	*	*	7.51
Sm	-3.53	*	*	-0.56	*	-1.47	*	30.70	0.90	*	*	-2.36	*
Sn	*	*	*	*	*	*	*	*	*	*	*	*	*
Sr	-1.73	*	*	*	*	0.57	-0.35	-1.95	1.06	-1.38	*	*	-1.15
Ta	*	*	*	*	*	*	*	*	*	*	*	*	*
Tb	*	*	*	3.51	*	-0.87	*	*	0.68	*	*	-0.88	*
Th	*	*	*	*	*	-1.08	*	-1.13	0.65	87.21	*	-0.87	*
Tl	*	*	*	*	*	*	*	*	0.25	*	*	*	*
Tm	*	*	*	-0.50	*	-0.83	*	*	0.88	*	*	-1.18	*
U	-1.93	*	*	*	*	-0.44	*	-3.35	0.99	6.47	*	-0.96	0.78
V	2.32	*	*	*	*	0.44	*	6.87	-0.65	6.87	*	-11.90	0.59
W	54.94	*	*	*	*	3.04	*	*	1.12	*	*	*	*
Y	-2.14	*	*	-5.45	*	-0.36	*	-2.65	-0.13	0.15	*	0.82	-0.64
Yb	-3.30	*	*	0.24	*	-1.10	*	*	1.44	-16.31	*	-1.46	*
Zn	2.82	*	*	*	*	1.09	*	-2.76	0.13	0.00	*	-1.00	-0.64
Zr	0.98	*	*	*	*	-0.01	*	-3.38	-10.16	-2.44	*	*	-2.26

Bold entries are Data Quality 1 - Underlined entries are Data Quality 2 - Entries in italics are derived from Provisional Values.

Table 3 - GeoPT46A Z-scores for Phosphate rock, POLC-1. 11/12/2019

Lab Code	G19	G20	G21	G22	G23	G24	G25	G26	G27	G28	G29	G30	G31
SiO2	-1.33	<u>3.30</u>	<u>5.88</u>	<b>0.06</b>	<b>0.00</b>	<u>-2.29</u>	-1.66	<u>-1.85</u>	-4.92	-1.94	0.61	<u>0.47</u>	<u>-0.19</u>
TiO2	-0.82	<u>-0.29</u>	<u>2.05</u>	-0.82	-1.55	*	-0.82	<u>-1.15</u>	6.56	-2.27	1.64	<u>0.21</u>	<u>-0.41</u>
Al2O3	-4.97	<u>1.91</u>	<u>5.21</u>	-0.99	2.48	<u>-3.35</u>	-1.49	<u>-0.50</u>	13.41	-0.47	-1.24	<u>1.99</u>	<u>-0.12</u>
Fe2O3T	-4.78	<u>-4.41</u>	<u>4.52</u>	-0.74	-0.17	<u>-0.26</u>	-1.41	<u>-1.44</u>	16.57	-2.37	1.40	<u>-0.76</u>	<u>-0.31</u>
MnO	-3.99	<u>-1.53</u>	<u>1.71</u>	1.10	-0.29	<u>0.55</u>	-0.75	<u>-0.84</u>	5.26	-1.84	1.10	<u>-13.62</u>	<u>-0.14</u>
MgO	0.00	<u>2.72</u>	<u>9.22</u>	2.31	-1.38	<u>0.23</u>	-1.84	<u>-0.92</u>	11.07	-1.24	-1.84	<u>-0.23</u>	<u>0.46</u>
CaO	-1.22	<u>1.36</u>	<u>-3.75</u>	1.97	-0.41	*	-0.71	<u>-0.65</u>	-1.50	-2.41	2.14	<u>-0.25</u>	<u>-4.92</u>
K2O	0.62	<u>7.53</u>	<u>0.31</u>	<u>-1.23</u>	-2.45	<u>-4.45</u>	-2.45	<u>-1.23</u>	3.69	-1.35	0.62	<u>-2.30</u>	<u>-1.84</u>
P2O5	-0.25	<u>-0.44</u>	<u>-1.36</u>	-2.31	2.06	*	-0.28	<u>-0.12</u>	-6.38	-4.65	3.24	<u>47.49</u>	<u>4.50</u>
LOI	-3.54	*	<u>-0.61</u>	<b>-0.88</b>	2.21	<u>-0.06</u>	1.88	*	7.74	-1.22	0.88	<u>1.88</u>	<u>-0.39</u>
As	0.42	<u>0.08</u>	*	<u>-1.55</u>	*	*	-6.24	*	-0.34	*	1.68	<u>0.42</u>	*
Ba	6.57	<u>1.05</u>	<u>-0.28</u>	<u>1.64</u>	-4.54	*	1.49	<u>-0.54</u>	3.94	*	-0.92	*	*
Be	0.27	<u>-0.24</u>	<u>0.24</u>	*	*	*	*	*	*	*	1.54	*	*
Bi	0.68	<u>0.00</u>	*	*	*	*	*	*	*	*	-0.41	*	*
C(tot)	*	*	*	*	*	*	*	<u>0.00</u>	*	<b>0.00</b>	*	*	*
Ce	1.17	<u>1.93</u>	<u>0.23</u>	<u>-3.00</u>	-0.75	*	6.15	<u>-0.39</u>	0.28	*	1.63	*	*
Co	-1.23	<u>-0.19</u>	<u>-0.17</u>	*	2.24	*	5.83	*	4.90	*	1.02	<u>-4.62</u>	*
Cr	2.85	<u>-0.39</u>	<u>-0.56</u>	*	-4.45	*	7.79	<u>-0.28</u>	3.39	*	0.28	<u>-4.45</u>	*
Cs	0.98	<u>-0.98</u>	<u>0.00</u>	*	-1.47	*	*	*	873.36	*	-0.74	*	*
Cu	-1.65	<u>-0.17</u>	<u>0.02</u>	<u>13.13</u>	4.65	*	-2.87	<u>-0.49</u>	1.17	*	-0.11	<u>-4.72</u>	*
Dy	1.16	<u>1.09</u>	<u>-0.12</u>	*	-4.71	*	*	*	*	*	-1.33	*	*
Er	1.70	<u>1.46</u>	<u>-0.03</u>	*	-1.54	*	*	*	*	*	-1.58	*	*
Eu	1.01	<u>0.73</u>	*	*	-1.59	*	*	*	*	*	-0.29	*	*
Gd	2.37	<u>1.78</u>	*	*	-0.66	*	*	*	*	*	-0.01	*	*
Hf	1.54	*	*	*	3.06	*	*	*	*	*	-0.79	*	*
Ho	1.48	<u>0.76</u>	<u>-0.13</u>	*	-1.44	*	*	*	*	*	-1.17	*	*
In	*	*	*	*	*	*	*	*	*	*	*	*	*
La	1.43	<u>1.98</u>	<u>0.25</u>	*	-1.93	*	7.57	<u>-1.57</u>	1.39	*	1.25	*	*
Li	-0.40	<u>-3.42</u>	<u>0.78</u>	*	*	*	*	*	*	*	-1.34	*	*
Lu	0.71	<u>0.53</u>	<u>-0.04</u>	*	-2.07	*	*	*	*	*	-1.06	*	*
Mo	0.62	*	<u>-0.37</u>	*	21.95	*	-2.14	*	2.14	*	-1.29	*	*
Nb	-0.02	*	*	<b>12.82</b>	<u>-1.96</u>	*	0.00	*	-6.84	*	-0.31	*	*
Nd	1.93	<u>2.48</u>	<u>0.20</u>	*	-4.64	*	-0.05	*	-0.26	*	2.51	*	*
Ni	0.40	<u>-0.32</u>	<u>-0.31</u>	<u>13.88</u>	12.00	*	-1.71	<u>-2.23</u>	-6.03	*	-1.14	<u>-3.94</u>	*
Pb	-0.56	<u>1.61</u>	<u>-0.69</u>	*	-4.31	*	0.00	*	2.56	*	2.03	<u>-4.37</u>	*
Pr	2.25	<u>2.00</u>	<u>0.04</u>	*	-1.46	*	*	*	*	*	-0.82	*	*
Rb	0.65	<u>-0.63</u>	<u>-0.53</u>	<u>0.06</u>	<u>-1.54</u>	*	3.34	*	8.47	*	1.95	*	*
Sb	21.97	<u>0.02</u>	<u>-1.69</u>	*	*	*	-4.36	*	*	*	0.02	*	*
Sc	-1.42	<u>-0.15</u>	<u>0.17</u>	*	0.23	*	*	*	161.97	*	1.18	*	*
Sm	1.30	<u>0.68</u>	<u>0.07</u>	*	-2.62	*	0.31	*	-4.86	*	1.46	*	*
Sn	3.08	<u>5.07</u>	<u>-0.89</u>	*	*	*	*	*	*	*	-0.72	*	*
Sr	2.15	<u>1.64</u>	<u>-0.12</u>	<b>0.09</b>	-0.09	*	-1.01	*	-1.50	*	1.35	*	*
Ta	2.86	*	*	*	-0.74	*	*	*	*	*	0.11	*	*
Tb	1.18	<u>1.08</u>	*	*	-1.76	*	*	*	*	*	1.01	*	*
Th	-2.68	<u>0.49</u>	<u>-0.40</u>	*	-0.97	*	-1.78	*	-3.88	*	0.36	*	*
Tl	2.44	*	<u>0.00</u>	*	*	*	*	*	*	*	0.00	*	*
Tm	0.97	<u>0.62</u>	<u>0.07</u>	*	-1.36	*	*	*	*	*	0.61	*	*
U	0.47	<u>-0.42</u>	<u>-0.13</u>	*	-1.09	*	-0.53	*	1.36	*	-0.07	*	*
V	1.91	<u>0.01</u>	<u>-0.12</u>	1.48	1.19	*	3.58	<u>-0.15</u>	5.40	*	0.90	<u>-5.24</u>	*
W	0.72	<u>-0.25</u>	*	*	1.32	*	139.08	*	160.37	*	0.38	*	*
Y	-0.15	<u>1.55</u>	<u>-0.33</u>	2.57	0.00	*	-0.31	<u>-0.46</u>	-0.75	*	-2.04	*	*
Yb	0.90	<u>1.11</u>	<u>0.40</u>	*	-3.14	*	-0.25	*	*	*	-0.40	*	*
Zn	2.01	<u>-0.00</u>	<u>0.90</u>	<u>0.64</u>	1.92	*	0.64	<u>0.32</u>	3.33	*	-1.57	<u>-5.13</u>	*
Zr	-1.30	*	<u>9.40</u>	2.14	3.81	*	-0.36	<u>-1.22</u>	0.39	-22.83	-1.67	*	*

Bold entries are Data Quality 1 - Underlined entries are Data Quality 2 - Entries in italics are derived from Provisional Values.





Table 3 - GeoPT46A Z-scores for Phosphate rock, POLC-1. 11/12/2019

Lab Code	G68	G70	G71	G72	G74	G75	G76	G77	G78	G79	G80	G82	G84
SiO2	<u>-0.03</u>	1.52	-27.46	-0.83	2.68	*	<u>0.97</u>	2.43	-0.33	*	<u>0.29</u>	-0.08	1.55
TiO2	<u>-0.29</u>	<u>0.58</u>	-13.11	-1.80	<u>6.97</u>	*	<u>0.45</u>	0.17	-10.41	*	-1.27	-0.65	<u>0.82</u>
Al2O3	<u>0.37</u>	<u>0.22</u>	-24.33	5.71	<u>-5.09</u>	*	<u>1.70</u>	0.50	-3.62	*	-0.12	-0.50	<u>-0.37</u>
Fe2O3T	<u>-0.42</u>	<u>0.02</u>	1.17	2.07	<u>-2.33</u>	*	<u>3.32</u>	1.06	-0.04	*	-0.34	-1.15	<u>0.03</u>
MnO	<u>1.59</u>	*	-6.30	1.10	<u>-23.50</u>	*	<u>1.64</u>	1.56	1.56	<u>3.81</u>	-2.22	-0.61	<u>-0.37</u>
MgO	<u>-0.23</u>	<u>0.83</u>	*	0.28	<u>2.08</u>	*	<u>1.48</u>	-2.31	-0.42	*	-0.30	-0.23	<u>1.38</u>
CaO	<u>0.05</u>	<u>0.35</u>	-9.14	5.66	<u>-4.84</u>	*	<u>0.70</u>	2.59	1.51	*	-1.27	-0.22	<u>-3.54</u>
K2O	<u>-2.30</u>	<u>-1.53</u>	6.77	-6.45	<u>3.38</u>	*	<u>1.69</u>	-0.92	0.31	*	-1.38	1.54	<u>6.45</u>
P2O5	<u>0.18</u>	<u>1.16</u>	-23.14	-0.96	<u>0.22</u>	*	<u>0.40</u>	0.25	-0.02	*	5.94	<u>0.23</u>	<u>0.00</u>
LOI	<u>0.00</u>	<u>0.32</u>	3.32	8.63	<u>0.83</u>	*	<u>1.60</u>	5.53	-5.97	*	<u>0.28</u>	-0.77	<u>-1.05</u>
As	<u>-0.56</u>	*	*	*	*	*	<u>0.31</u>	*	2.28	<u>1.09</u>	*	-0.88	*
Ba	<u>-2.53</u>	*	*	-1.71	<u>-6.57</u>	<u>0.04</u>	<u>1.26</u>	*	-3.11	<u>0.91</u>	-0.15	-0.41	0.95
Be	*	*	*	1.58	*	<u>0.00</u>	*	*	6.23	*	*	*	<u>-0.10</u>
Bi	*	*	*	*	*	*	*	*	31.80	*	*	*	*
C(tot)	*	<u>0.00</u>	*	*	*	*	<u>-0.43</u>	<u>-3.38</u>	*	*	*	*	*
Ce	<u>0.81</u>	*	*	-31.37	*	-0.19	<u>1.00</u>	*	4.64	1.35	0.64	-0.20	1.03
Co	<u>0.22</u>	*	*	-0.07	-6.78	-0.06	<u>0.92</u>	*	6.24	1.38	-2.83	*	<u>0.58</u>
Cr	<u>-0.42</u>	*	58.98	-0.67	<u>5.01</u>	-0.45	<u>-0.65</u>	*	-4.74	<u>1.36</u>	<u>1.39</u>	0.83	<u>0.58</u>
Cs	*	*	*	*	*	<u>0.00</u>	*	*	2.45	*	*	*	<u>2.45</u>
Cu	<u>0.68</u>	*	99.54	-0.56	<u>1.39</u>	-0.49	<u>6.52</u>	*	6.05	<u>-4.72</u>	-1.90	<u>2.33</u>	<u>0.16</u>
Dy	<u>0.37</u>	*	*	0.30	*	<u>0.21</u>	<u>0.59</u>	*	3.73	*	-2.43	*	-0.15
Er	<u>0.34</u>	*	*	-0.26	*	<u>0.24</u>	<u>0.92</u>	*	3.39	*	-0.05	*	-0.40
Eu	<u>0.25</u>	*	*	1.52	*	<u>0.39</u>	<u>0.44</u>	*	3.22	*	*	*	-0.00
Gd	<u>0.88</u>	*	*	0.07	*	<u>0.16</u>	<u>1.01</u>	*	5.18	*	-1.54	*	-0.57
Hf	*	*	*	-3.57	*	-0.55	<u>0.00</u>	*	-2.18	*	<u>12.37</u>	*	<u>2.43</u>
Ho	<u>0.16</u>	*	*	0.60	*	<u>0.22</u>	<u>0.36</u>	*	4.53	*	-4.79	*	<u>0.34</u>
In	*	*	*	*	*	*	*	*	0.69	*	*	*	*
La	<u>0.65</u>	*	*	0.16	<u>-13.69</u>	-0.73	<u>0.80</u>	*	4.21	<u>2.07</u>	-1.64	-0.79	<u>0.45</u>
Li	*	*	*	*	*	<u>0.60</u>	*	*	1.82	*	<u>7.00</u>	*	*
Lu	<u>0.42</u>	*	*	1.10	*	-0.13	<u>0.25</u>	*	2.71	*	*	*	-0.02
Mo	*	*	*	0.54	*	*	<u>1.76</u>	*	3.86	<u>0.37</u>	*	*	<u>1.07</u>
Nb	<u>-0.21</u>	*	*	2.14	<u>19.23</u>	<u>0.10</u>	<u>0.30</u>	*	-2.07	*	*	*	<u>0.43</u>
Nd	<u>-1.26</u>	*	*	1.99	*	-0.10	<u>1.06</u>	*	4.29	*	-0.35	*	<u>0.17</u>
Ni	<u>0.17</u>	*	10.63	-0.36	<u>-3.94</u>	-0.03	<u>-1.92</u>	*	6.03	<u>-0.15</u>	<u>-4.63</u>	<u>0.79</u>	<u>1.23</u>
Pb	<u>-2.19</u>	*	2.19	5.43	<u>-5.93</u>	<u>0.73</u>	<u>2.01</u>	*	-2.08	<u>0.24</u>	*	-0.34	<u>-3.20</u>
Pr	<u>0.11</u>	*	*	1.01	*	-0.60	<u>0.48</u>	*	1.92	*	-0.85	*	<u>0.24</u>
Rb	<u>1.35</u>	*	3.34	-0.77	<u>118.75</u>	<u>0.00</u>	<u>2.40</u>	*	4.94	<u>1.97</u>	*	*	<u>2.79</u>
Sb	<u>-3.91</u>	*	*	*	*	*	<u>0.24</u>	*	4.59	*	*	*	*
Sc	<u>-0.29</u>	*	*	*	*	-0.10	<u>0.30</u>	*	7.35	<u>7.42</u>	*	*	<u>0.09</u>
Sm	<u>0.11</u>	*	*	0.86	*	<u>0.17</u>	<u>0.76</u>	*	4.29	*	1.81	*	-0.08
Sn	*	*	*	*	*	*	*	*	15.27	*	*	*	<u>0.44</u>
Sr	<u>-0.55</u>	*	-5.47	-4.32	<u>-6.39</u>	<u>0.46</u>	<u>1.28</u>	-2.67	-2.25	-0.73	-0.69	-0.74	-0.19
Ta	*	*	*	1.70	*	<u>0.18</u>	<u>-0.42</u>	*	10.32	*	*	*	<u>0.37</u>
Tb	<u>0.16</u>	*	*	0.98	*	<u>0.16</u>	-0.02	*	0.80	*	-1.53	*	-0.10
Th	<u>1.05</u>	*	*	0.08	*	<u>0.49</u>	<u>0.93</u>	*	4.92	<u>-0.62</u>	*	*	<u>0.49</u>
Tl	*	*	*	*	*	*	*	*	1.46	*	*	*	-1.97
Tm	<u>0.41</u>	*	*	*	*	<u>0.26</u>	<u>0.37</u>	*	2.99	*	*	*	-0.29
U	<u>0.40</u>	*	-0.53	1.78	*	<u>0.22</u>	<u>0.99</u>	*	8.43	<u>0.50</u>	*	-1.14	-0.09
V	<u>0.86</u>	*	-2.10	-0.84	<u>2.83</u>	-0.26	<u>1.86</u>	*	-0.58	<u>1.99</u>	*	-0.14	<u>0.94</u>
W	*	*	169.50	4.05	*	*	*	*	13.89	*	*	*	<u>1.62</u>
Y	<u>-0.80</u>	*	-9.06	1.18	*	<u>0.21</u>	<u>0.96</u>	-0.67	-0.56	<u>0.33</u>	-1.36	-0.64	<u>1.65</u>
Yb	<u>0.56</u>	*	*	2.31	*	<u>0.64</u>	<u>0.53</u>	*	2.94	*	-0.12	*	-0.04
Zn	<u>0.48</u>	*	10.26	-1.13	<u>4.81</u>	-1.35	-0.20	*	-2.30	<u>0.42</u>	<u>0.96</u>	<u>0.42</u>	<u>0.73</u>
Zr	<u>0.34</u>	*	6.72	-13.57	<u>6.49</u>	-1.26	-1.27	*	-11.42	-0.20	<u>12.94</u>	-1.01	<u>1.76</u>

Bold entries are Data Quality 1 - Underlined entries are Data Quality 2 - Entries in italics are derived from Provisional Values.

Table 3 - GeoPT46A Z-scores for Phosphate rock, POLC-1. 11/12/2019

Lab Code	G86	G88	G90	G92	G94	G95	G96	G99	G101	G102	G103	G104	G106
SiO2	0.72	-0.04	-1.16	<u>0.27</u>	8.45	-1.88	-1.19	-0.52	1.27	4.19	*	*	0.64
TiO2	-3.28	-1.55	83.29	<u>0.45</u>	1.64	-0.82	-0.90	-0.41	1.15	-4.59	*	*	<u>0.82</u>
Al2O3	-0.50	-0.10	1.24	<u>1.02</u>	1.74	0.99	-0.25	-0.62	2.98	-11.01	*	*	<u>0.74</u>
Fe2O3T	0.39	-0.61	3.85	-0.36	-0.74	2.19	-1.38	0.08	0.28	1.94	*	*	<u>1.15</u>
MnO	8.04	-0.01	0.18	-0.35	3.41	*	-1.72	0.32	0.73	1.59	*	-0.29	<u>0.55</u>
MgO	2.77	-1.71	20.29	-1.38	0.46	5.07	-0.69	0.00	-2.31	3.00	*	*	<u>1.15</u>
CaO	2.41	0.94	-0.63	-0.00	3.18	-0.04	-2.80	-0.17	0.00	-0.72	*	*	<u>1.16</u>
K2O	0.62	-1.84	0.62	*	6.77	-2.45	1.85	-1.23	3.69	10.14	*	*	-1.23
P2O5	-0.03	-1.41	-1.38	<u>2.02</u>	-8.23	-0.74	-1.20	0.37	-1.36	-0.28	*	*	<u>0.18</u>
LOI	3.76	-1.28	6.74	-1.38	-1.33	2.54	<u>2.16</u>	-2.93	*	-1.93	*	*	<u>0.00</u>
As	-3.09	*	2.42	*	4.20	*	*	-0.37	3.20	15.53	*	*	*
Ba	0.21	-2.67	0.59	-0.70	-0.48	*	-1.37	-0.34	1.62	1.96	-2.39	0.34	-1.24
Be	*	<u>0.64</u>	*	-0.45	0.21	*	<u>0.00</u>	<u>0.24</u>	0.82	*	-2.01	0.14	*
Bi	*	*	*	*	*	*	*	*	*	293.11	3.42	*	*
C(tot)	*	*	*	*	*	-1.65	*	<u>0.42</u>	*	*	*	*	*
Ce	-8.85	-1.53	1.43	<u>0.01</u>	2.14	*	-0.92	-0.27	5.70	-0.76	0.35	0.87	-3.06
Co	-1.35	<u>0.26</u>	1.52	<u>0.33</u>	0.62	*	-2.11	-0.06	1.00	*	6.46	0.30	*
Cr	0.00	<u>2.25</u>	21.14	<u>2.14</u>	1.37	*	*	0.00	0.28	<u>22.12</u>	*	-0.83	-2.23
Cs	677.10	<u>0.79</u>	1854.67	*	-0.69	*	<u>0.74</u>	*	*	*	-0.34	0.00	*
Cu	-3.80	-1.17	-2.87	<u>3.31</u>	-1.48	*	-2.84	<u>0.92</u>	2.64	-5.47	-1.79	-1.64	*
Dy	*	-0.80	*	<u>0.00</u>	-0.29	*	<u>0.49</u>	-0.42	-1.36	11.99	-0.81	0.68	*
Er	*	-0.62	*	<u>0.14</u>	-0.57	*	<u>0.36</u>	<u>0.06</u>	0.05	*	-0.55	-0.27	*
Eu	*	<u>0.21</u>	*	-0.47	-0.23	*	<u>0.50</u>	-0.25	-1.39	*	-1.27	0.29	*
Gd	-16.17	-0.84	*	-1.41	-0.23	*	<u>0.48</u>	-0.41	0.07	*	-2.76	0.31	*
Hf	*	-4.06	*	<u>0.54</u>	0.08	*	*	<u>0.06</u>	*	*	-9.29	-7.36	*
Ho	*	-0.57	*	<u>0.14</u>	-0.09	*	<u>0.49</u>	-0.33	-1.10	*	-0.68	0.21	*
In	*	*	*	*	*	*	*	*	*	*	*	*	*
La	-6.30	-2.33	2.92	<u>0.14</u>	2.02	*	<u>1.07</u>	-0.35	3.93	-0.64	-2.08	1.44	-2.65
Li	*	-1.31	*	*	0.57	*	<u>0.50</u>	-0.39	0.70	*	1.06	-0.19	*
Lu	*	-0.60	*	-0.00	-0.99	*	<u>0.26</u>	-0.29	-0.00	*	-0.36	0.35	*
Mo	*	*	*	<u>0.75</u>	-0.66	*	<u>0.16</u>	-1.07	19.49	-4.82	-2.30	-0.43	*
Nb	2.14	-2.87	8.55	-1.02	0.02	*	11.75	-0.64	*	-4.06	*	-1.56	*
Nd	-6.54	<u>0.01</u>	-2.96	-0.07	1.39	*	<u>1.26</u>	<u>0.05</u>	-1.51	-1.07	-1.64	0.90	<u>0.12</u>
Ni	7.20	<u>1.79</u>	8.57	<u>0.10</u>	0.12	*	<u>2.57</u>	-0.51	12.15	<u>4.04</u>	5.39	0.07	<u>4.97</u>
Pb	3.43	-2.33	-6.24	<u>0.16</u>	-2.29	*	-1.40	<u>0.47</u>	-1.25	<u>0.05</u>	*	-1.22	<u>7.18</u>
Pr	*	<u>0.33</u>	*	<u>0.01</u>	1.60	*	<u>1.38</u>	-0.12	-1.26	*	-2.77	0.06	*
Rb	12.96	<u>0.88</u>	32.21	-0.24	-0.48	*	<u>6.48</u>	<u>0.22</u>	*	<u>1.03</u>	-1.16	0.32	*
Sb	*	*	*	*	4.34	*	<u>0.29</u>	<u>0.29</u>	*	*	-4.81	-3.22	*
Sc	*	-0.42	58.50	-0.65	2.78	*	<u>1.44</u>	<u>0.26</u>	0.15	10.22	0.21	-0.26	*
Sm	*	-0.23	*	-0.59	-0.71	*	<u>0.53</u>	-0.27	-1.88	<u>5.64</u>	-1.52	-2.65	*
Sn	*	*	*	*	1.26	*	*	*	*	*	-6.47	3.97	*
Sr	-3.77	-0.53	-1.29	<u>0.07</u>	1.00	*	-2.21	<u>0.69</u>	-1.93	<u>0.15</u>	0.83	0.60	-1.01
Ta	*	-1.97	*	*	-4.35	*	*	-0.37	*	*	-0.92	-4.79	*
Tb	*	-0.84	*	-0.05	-0.48	*	<u>0.10</u>	-0.34	0.62	*	-0.86	0.72	*
Th	1.46	-0.51	7.93	<u>0.00</u>	-0.19	*	-0.08	<u>0.00</u>	-1.41	-7.04	2.04	0.49	*
Tl	*	*	*	*	-0.06	*	<u>0.56</u>	<u>0.28</u>	0.56	299.39	*	-0.56	*
Tm	*	-0.62	*	-0.19	-0.03	*	<u>0.52</u>	-0.26	-1.07	*	-0.72	0.10	*
U	*	<u>0.28</u>	-1.93	-0.18	2.27	*	-0.97	<u>0.26</u>	-0.05	-1.35	3.51	-0.46	*
V	-0.01	<u>1.68</u>	*	<u>0.43</u>	1.03	*	-4.34	<u>0.44</u>	-3.22	-0.36	-2.37	0.50	<u>5.67</u>
W	*	*	*	*	0.00	*	*	*	*	*	*	0.71	*
Y	-8.70	-2.85	0.98	<u>1.63</u>	1.99	*	<u>0.26</u>	-0.57	3.19	-0.94	-0.92	-0.36	-2.65
Yb	*	-0.46	*	-0.24	-0.37	*	<u>0.44</u>	-0.18	0.04	10.32	-0.04	0.24	*
Zn	0.00	<u>1.33</u>	2.56	-0.06	-1.11	*	<u>0.96</u>	-0.32	-6.41	-1.83	-6.44	-3.46	<u>1.92</u>
Zr	3.39	-6.94	1.31	<u>0.75</u>	3.50	*	*	<u>1.70</u>	-7.43	<u>2.40</u>	-19.68	-15.89	<u>2.32</u>

Bold entries are Data Quality 1 - Underlined entries are Data Quality 2 - Entries in italics are derived from Provisional Values.

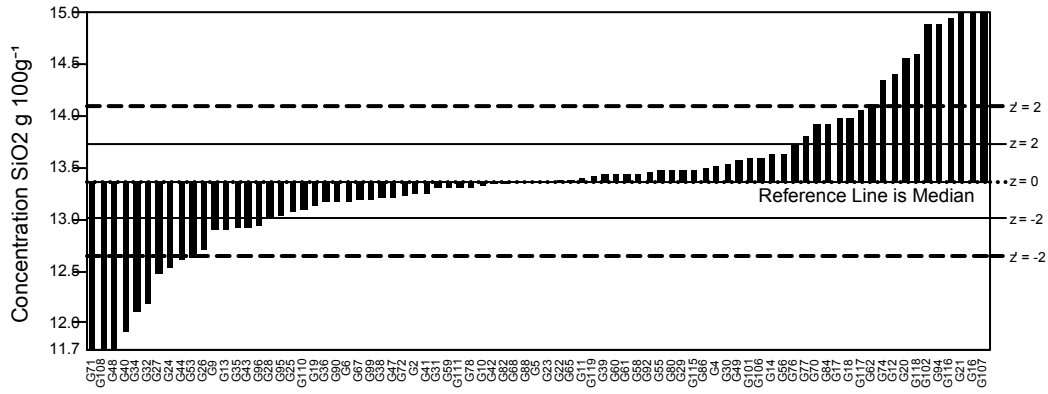
Table 3 - GeoPT46A Z-scores for Phosphate rock, POLC-1. 11/12/2019

Lab Code	G107	G108	G109	G110	G111	G112	G113	G114	G115	G116	G117	G118	G119
SiO2	13.43	-26.52	*	-1.49	<u>-0.17</u>	*	*	*	<u>0.30</u>	<u>4.34</u>	<u>1.88</u>	<u>6.80</u>	<u>0.14</u>
TiO2	-5.73	1.89	*	-0.82	<u>-0.41</u>	*	*	<b>6.44</b>	<u>2.05</u>	<u>1.44</u>	<u>0.33</u>	-6.47	<u>-0.41</u>
Al2O3	-4.22	3.23	*	-1.99	<u>0.87</u>	*	*	-0.19	<u>16.39</u>	<u>1.42</u>	<u>0.37</u>	0.99	<u>0.25</u>
Fe2O3T	-3.77	1.17	*	1.62	<u>0.14</u>	*	*	2.32	<u>6.60</u>	<u>0.78</u>	<u>-0.82</u>	0.05	<u>0.31</u>
MnO	-3.52	1.01	*	0.18	<u>-1.30</u>	*	*	-0.96	<u>7.03</u>	<u>-0.10</u>	<u>-0.86</u>	-0.75	<u>-6.50</u>
MgO	0.92	1.38	*	0.46	<u>0.23</u>	*	*	-0.86	<u>22.13</u>	<u>1.61</u>	<u>-0.69</u>	3.69	<u>-0.23</u>
CaO	1.50	0.73	*	0.94	<u>0.66</u>	*	*	-2.23	<u>0.95</u>	<u>-0.25</u>	<u>0.83</u>	-1.73	<u>0.53</u>
K2O	*	0.62	*	0.62	<u>0.31</u>	*	*	<b>5.81</b>	<u>3.38</u>	<u>-0.15</u>	<u>0.31</u>	-23.96	<u>-1.23</u>
P2O5	2.53	-19.20	*	-2.71	<u>0.25</u>	*	*	-2.80	<u>1.23</u>	<u>3.65</u>	<u>0.62</u>	-6.41	<u>1.16</u>
LOI	-4.53	-4.09	*	0.33	<u>-1.77</u>	*	*	*	*	*	<u>0.22</u>	2.21	<u>-2.82</u>
As	*	*	-9.78	<b>0.84</b>	<u>-0.88</u>	*	<b>17.65</b>	<b>-18.77</b>	*	*	<u>-1.55</u>	<b>4.62</b>	<u>3.81</u>
Ba	6.88	-0.82	-3.38	0.98	<u>1.13</u>	<u>-0.09</u>	3.09	-0.10	<u>4.53</u>	<u>0.35</u>	<u>0.23</u>	-2.87	*
Be	-0.34	*	*	*	<u>0.72</u>	*	1.06	0.70	*	<u>0.62</u>	<u>-0.10</u>	-4.18	<u>-2.16</u>
Bi	2.45	*	*	*	*	*	-0.16	0.29	*	<u>1.47</u>	*	0.00	*
C(tot)	*	*	*	*	<u>-4.22</u>	*	*	*	*	<u>-2.68</u>	*	3.59	*
Ce	-3.64	-1.43	8.29	2.89	<u>0.86</u>	<u>-0.28</u>	1.65	-0.49	<u>-6.13</u>	<u>0.03</u>	<u>0.30</u>	-5.21	*
Co	-2.23	*	-7.45	0.09	<u>0.55</u>	*	3.70	0.66	*	<i>1054.36</i>	<u>-1.03</u>	-4.22	<u>-1.75</u>
Cr	6.69	2.23	-7.96	-0.56	*	*	-1.59	-0.45	*	<i>1084.15</i>	<u>0.28</u>	-7.68	<u>5.01</u>
Cs	*	-0.98	-1.47	*	*	<u>0.49</u>	1.18	-0.19	*	<u>0.29</u>	*	0.00	*
Cu	-0.69	<b>8.41</b>	<b>-7.00</b>	<b>7.47</b>	*	*	<b>1.95</b>	<b>-0.15</b>	<u>57.76</u>	<u>-0.73</u>	<u>4.20</u>	<u>0.23</u>	<u>-0.68</u>
Dy	-0.39	2.05	5.87	*	<u>1.55</u>	<u>0.12</u>	2.08	0.82	*	<u>0.71</u>	<u>-0.36</u>	-0.15	*
Er	-1.36	0.44	3.61	*	<u>1.30</u>	<u>-0.51</u>	1.76	0.04	*	<u>-0.18</u>	<u>-0.69</u>	0.69	*
Eu	-2.86	1.35	94.20	*	<u>0.59</u>	<u>-0.15</u>	1.68	0.11	*	<u>0.09</u>	<u>0.39</u>	-0.60	*
Gd	-0.90	0.53	15.34	*	<u>-0.80</u>	<u>-2.18</u>	2.53	-0.66	*	<u>0.93</u>	<u>0.28</u>	-0.17	*
Hf	*	0.79	*	*	<u>37.94</u>	<u>4.28</u>	-11.31	5.34	*	<u>0.15</u>	<u>0.54</u>	*	*
Ho	*	1.70	82.68	*	<u>0.63</u>	<u>-0.43</u>	1.55	0.03	*	<u>0.34</u>	<u>-0.43</u>	-0.15	*
In	-2.43	*	*	*	*	*	*	*	*	<u>0.00</u>	*	-1.04	*
La	-3.74	-0.54	5.61	4.07	<u>0.82</u>	<u>-0.09</u>	3.81	-0.81	<u>-5.07</u>	<u>0.00</u>	<u>0.11</u>	-5.49	*
Li	*	*	*	*	<u>-1.41</u>	*	0.39	-0.37	*	<u>0.20</u>	*	-1.29	*
Lu	-1.68	0.04	0.79	*	<u>1.59</u>	<u>-0.35</u>	0.92	-0.66	*	<u>0.45</u>	<u>-0.09</u>	-0.00	*
Mo	*	*	*	*	*	*	-6.18	-1.35	*	<u>-0.18</u>	*	2.46	*
Nb	*	-0.77	*	*	*	<u>0.32</u>	-15.28	0.18	<u>121.81</u>	<u>1.10</u>	<u>0.00</u>	0.26	*
Nd	-2.09	-0.02	8.48	-2.89	<u>0.41</u>	<u>0.10</u>	3.11	-0.27	<u>-1.81</u>	<u>0.46</u>	<u>0.05</u>	-0.63	*
Ni	-0.87	1.03	-7.47	1.03	*	*	3.28	3.66	*	<u>1.40</u>	<u>-0.17</u>	3.08	<u>1.20</u>
Pb	1.25	0.04	-1.87	0.00	<u>0.05</u>	*	1.72	-0.21	*	<u>0.10</u>	<u>-1.25</u>	0.62	<u>-0.47</u>
Pr	-3.24	-0.20	7.32	*	<u>0.83</u>	<u>-0.09</u>	<b>2731.92</b>	0.00	<u>4.69</u>	<u>0.56</u>	<u>-0.18</u>	-0.38	*
Rb	3.40	1.73	*	-9.49	<u>1.19</u>	<u>-0.61</u>	8.55	-0.16	*	<u>0.85</u>	<u>0.06</u>	1.99	*
Sb	25.29	*	-2.38	*	<u>-0.08</u>	*	-6.09	*	*	<u>-0.28</u>	<u>0.79</u>	-0.01	<u>10.18</u>
Sc	2.31	0.34	*	*	<u>0.08</u>	*	0.20	-0.87	*	<u>0.88</u>	<u>0.26</u>	-4.10	*
Sm	-2.15	1.27	3.90	*	<u>1.04</u>	<u>-0.51</u>	2.36	0.00	*	<u>0.88</u>	<u>0.24</u>	-0.35	*
Sn	5.92	*	1.09	*	<u>2.50</u>	*	-10.05	-0.27	*	<u>0.18</u>	<u>4.55</u>	-0.35	*
Sr	-1.43	1.06	-5.56	2.21	<u>0.48</u>	<u>0.18</u>	5.97	0.93	<u>0.94</u>	<u>0.89</u>	<u>0.76</u>	6.80	<u>-1.33</u>
Ta	*	0.00	*	*	*	<u>4.98</u>	-8.44	2.64	*	<u>-0.15</u>	*	5.16	*
Tb	-0.46	1.38	94.51	*	<u>2.11</u>	<u>-0.62</u>	1.25	0.58	*	<u>-0.05</u>	<u>0.49</u>	*	*
Th	-3.06	0.91	6.31	7.93	*	<u>0.16</u>	-1.46	0.34	*	<u>-0.04</u>	<u>0.00</u>	-12.60	*
Tl	*	*	-3.38	*	<u>0.84</u>	*	-3.72	0.90	*	<u>-1.61</u>	<u>0.84</u>	-0.56	<u>259.96</u>
Tm	-2.27	0.46	2.70	*	<u>0.70</u>	<u>-0.08</u>	1.01	-0.21	*	<u>0.35</u>	<u>-0.58</u>	-0.23	*
U	-2.35	0.05	9.83	-2.63	<u>2.25</u>	<u>-0.48</u>	0.59	0.18	*	<u>1.24</u>	<u>0.26</u>	0.59	*
V	-0.45	2.08	-11.19	-0.91	*	*	-15.90	-0.02	*	<u>0.53</u>	<u>0.44</u>	-1.45	<u>-1.20</u>
W	*	*	*	*	*	*	-1.46	1.50	*	<u>-1.68</u>	<u>3.65</u>	-0.10	*
Y	-2.57	2.16	-1.54	2.52	<u>0.90</u>	<u>0.44</u>	3.66	1.29	<u>-0.08</u>	<u>1.51</u>	<u>-0.21</u>	1.60	*
Yb	-1.77	-0.33	5.86	*	<u>2.65</u>	<u>0.16</u>	1.74	0.42	*	<u>0.52</u>	<u>-0.44</u>	0.32	*
Zn	0.90	0.00	-8.91	0.64	<u>1.41</u>	*	7.61	-2.44	*	<u>2.26</u>	<u>-0.96</u>	-6.09	<u>-0.32</u>
Zr	6.18	2.14	*	8.39	*	<u>1.24</u>	-20.90	6.02	*	<u>0.83</u>	<u>-0.80</u>	-10.43	*

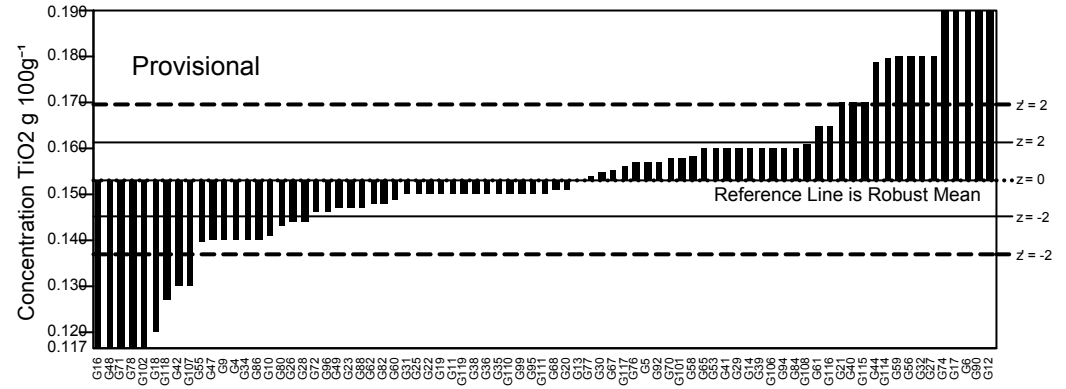
Bold entries are Data Quality 1 - Underlined entries are Data Quality 2 - Entries in italics are derived from Provisional Values.



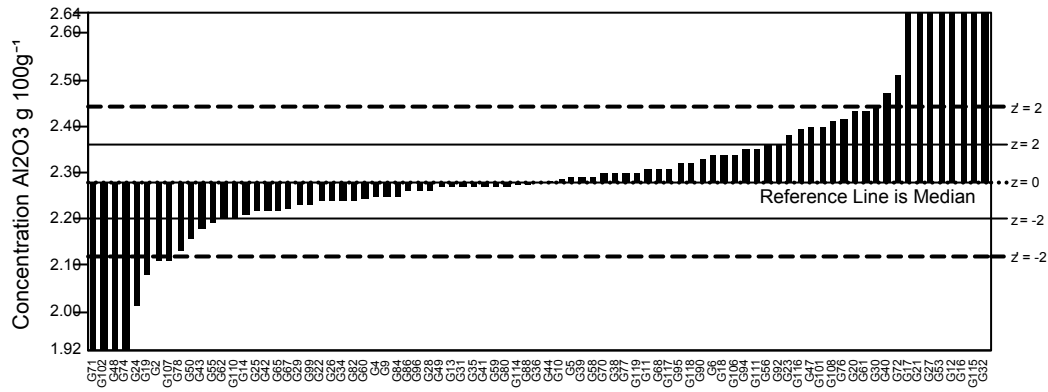
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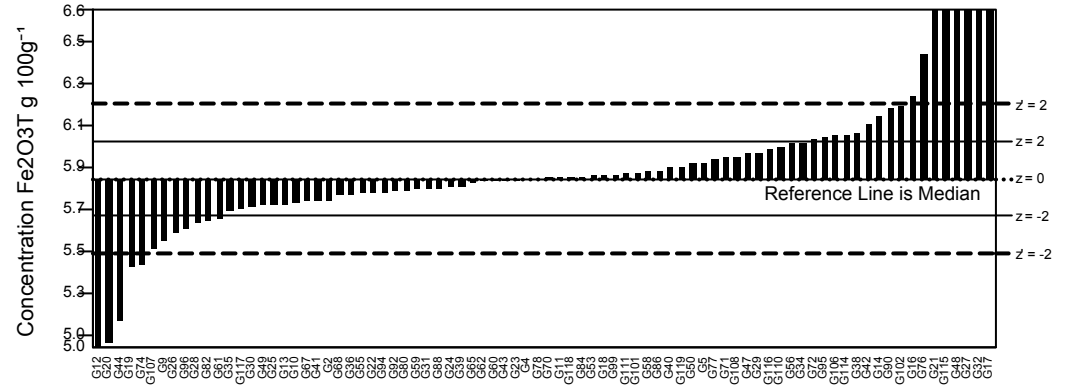
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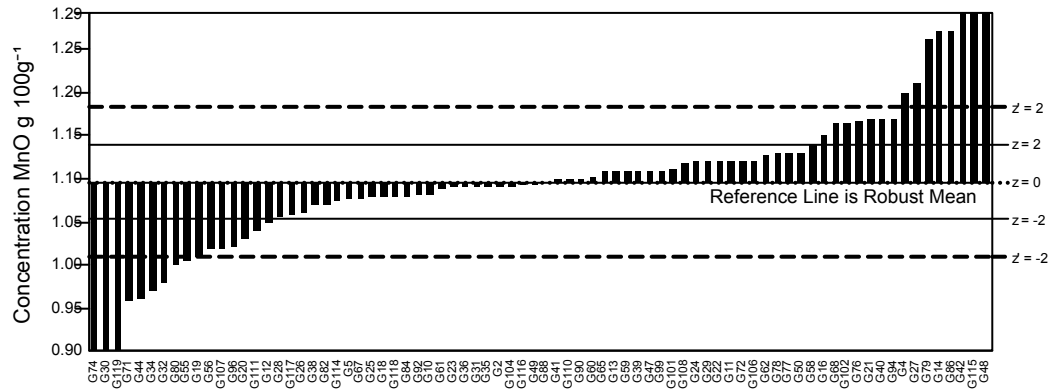
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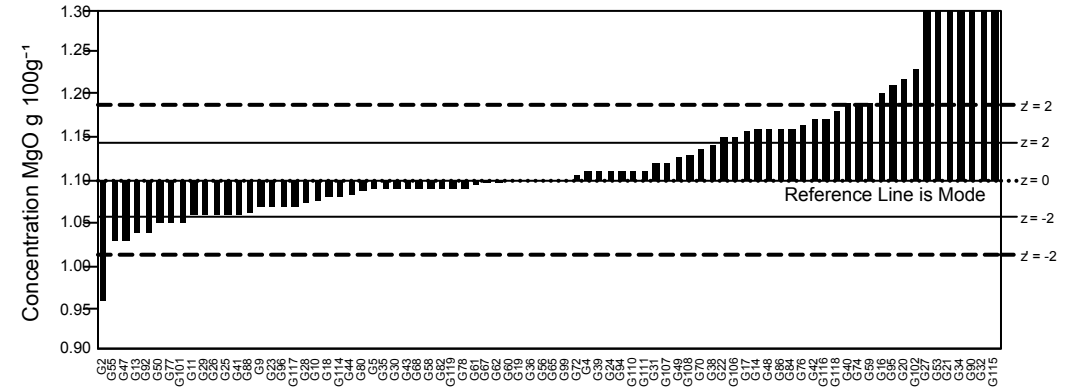
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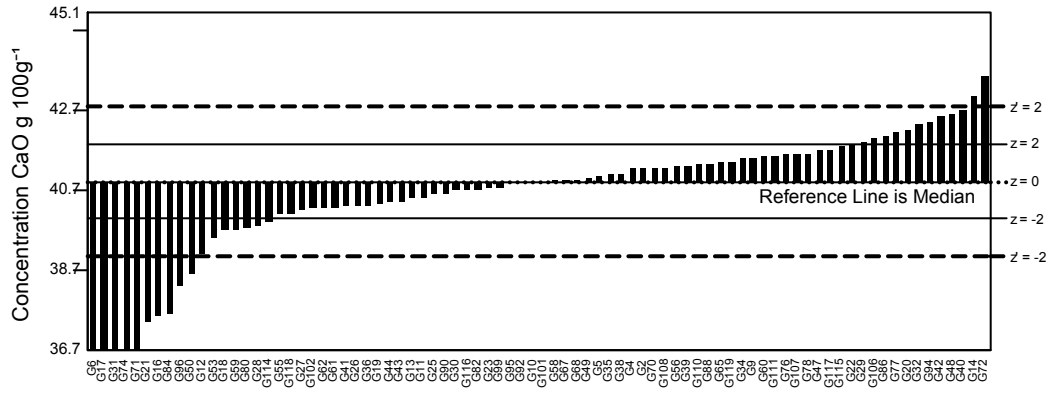
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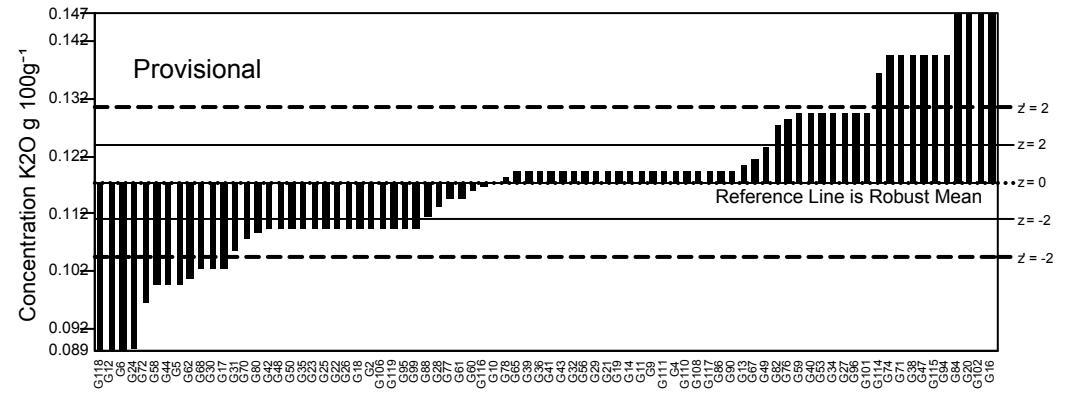
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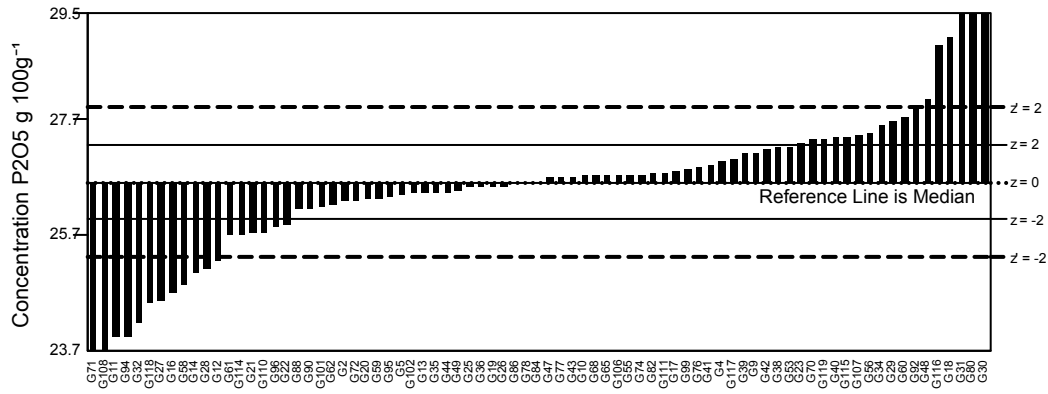
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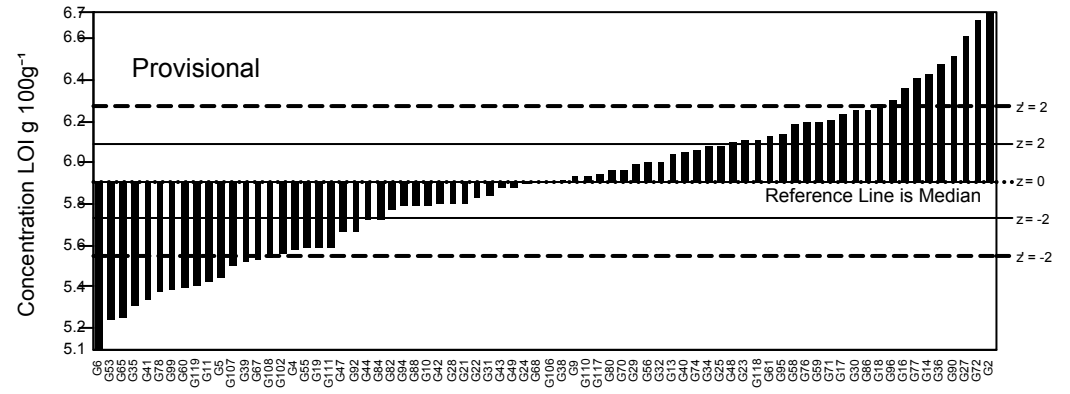
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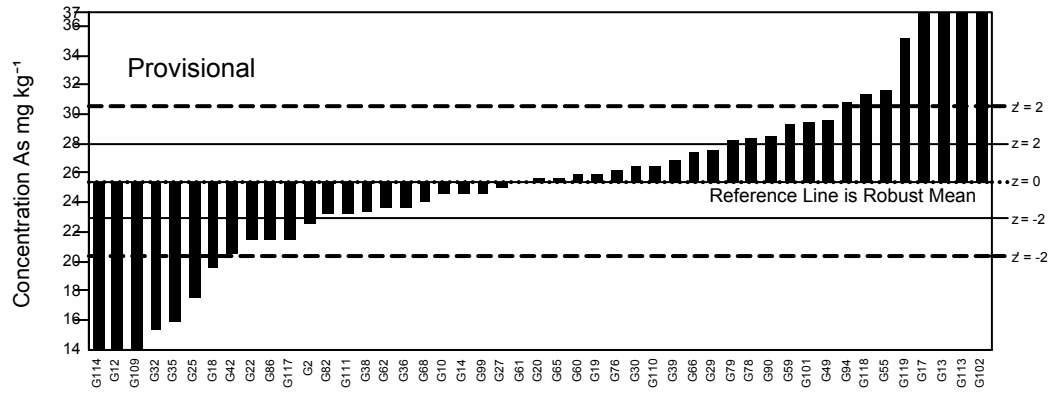
GeoPT46A - Barchart for P2O5



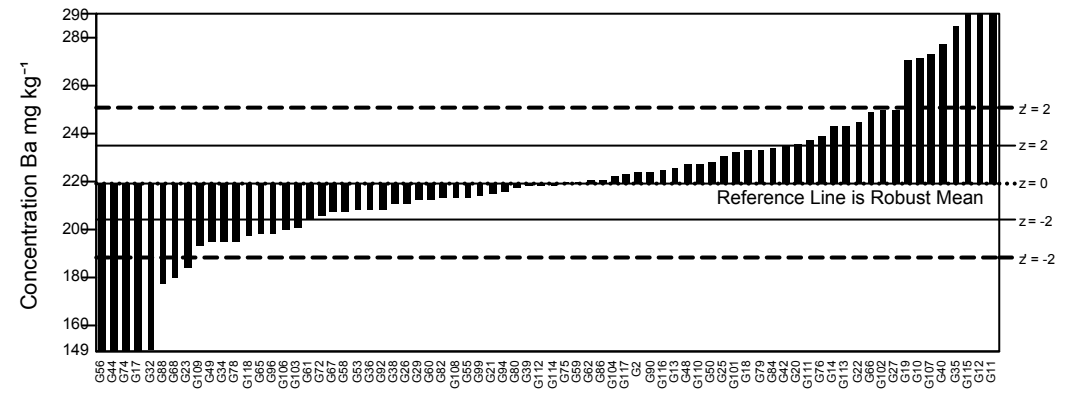
GeoPT46A - Barchart for LOI



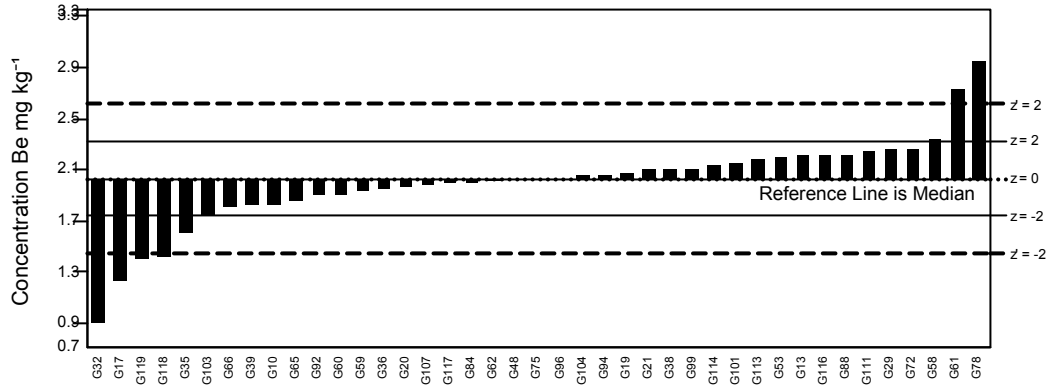
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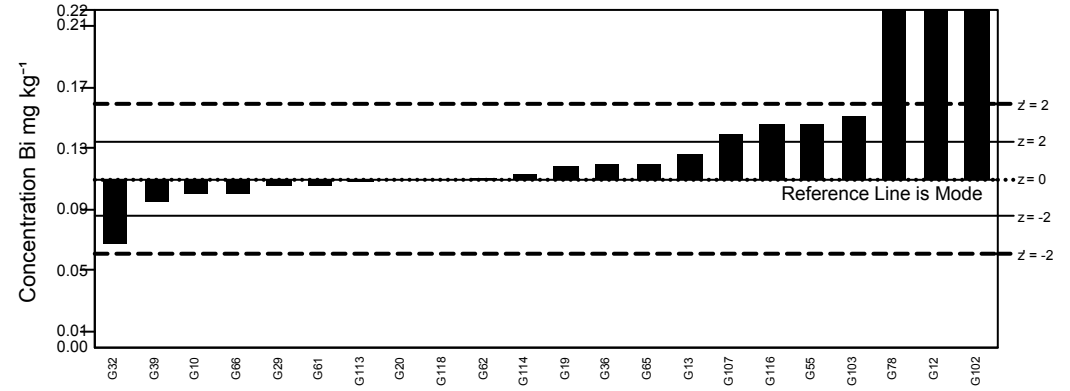
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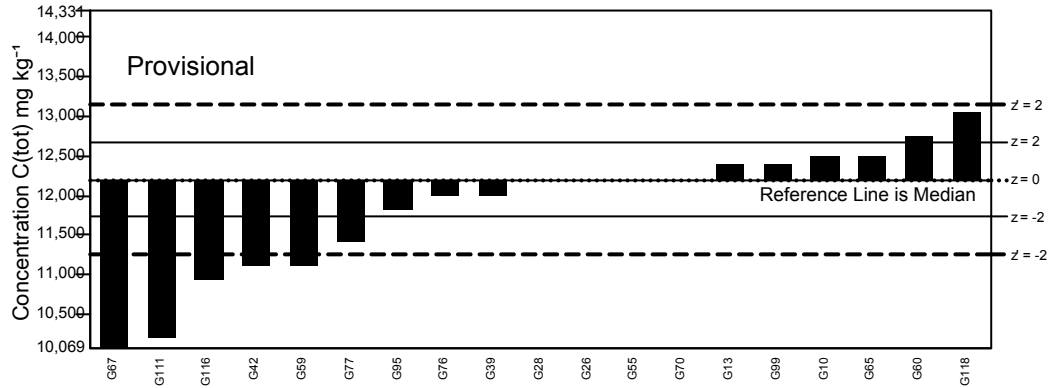
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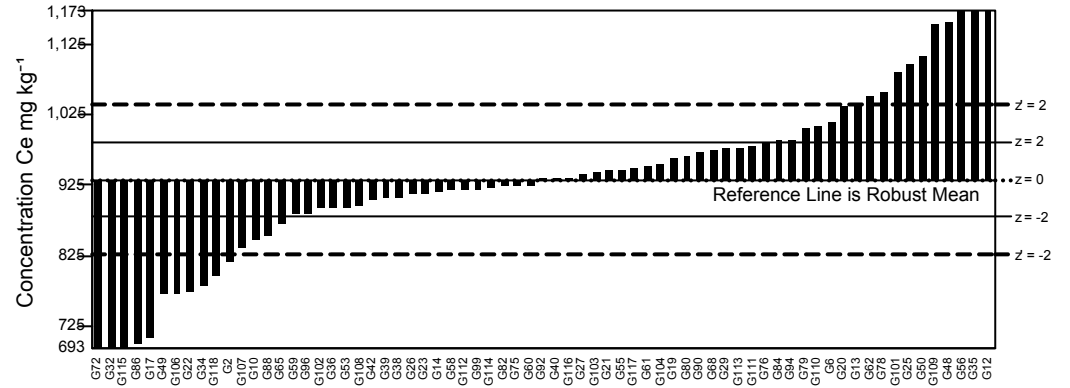
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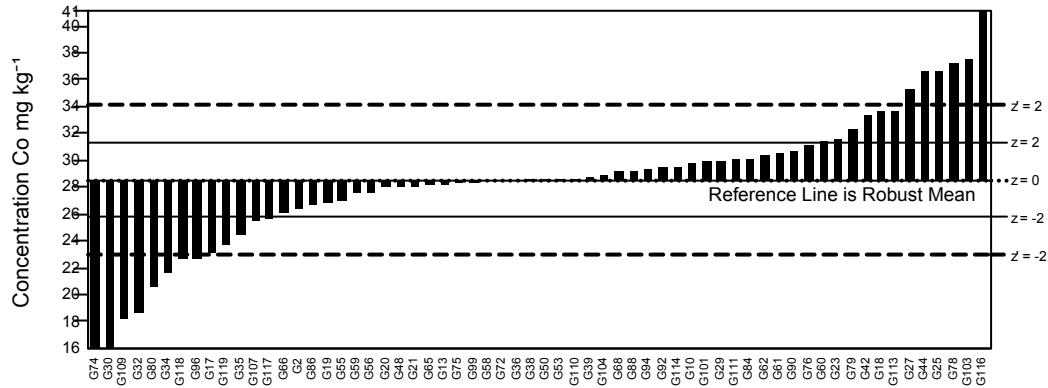
GeoPT46A - Barchart for C(tot)



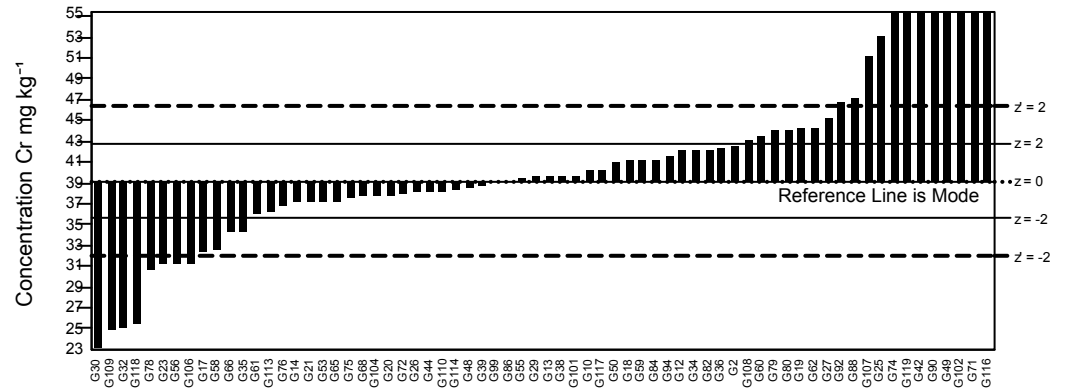
GeoPT46A - Barchart for Ce



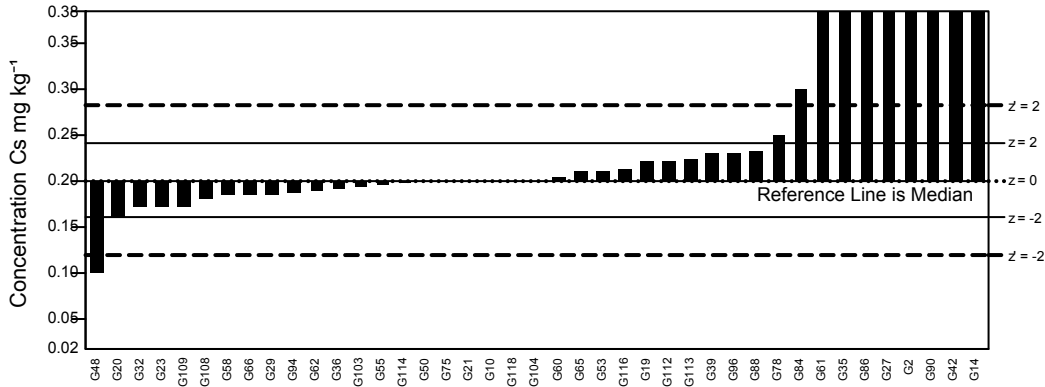
GeoPT46A - Barchart for Co



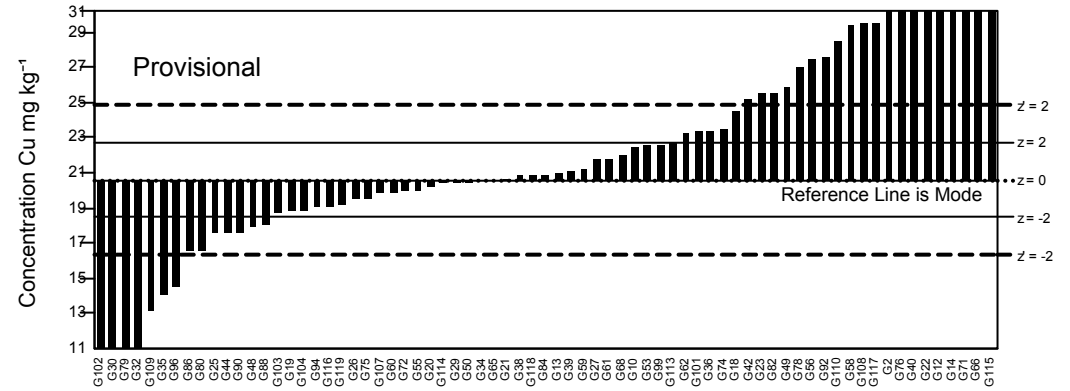
GeoPT46A - Barchart for Cr



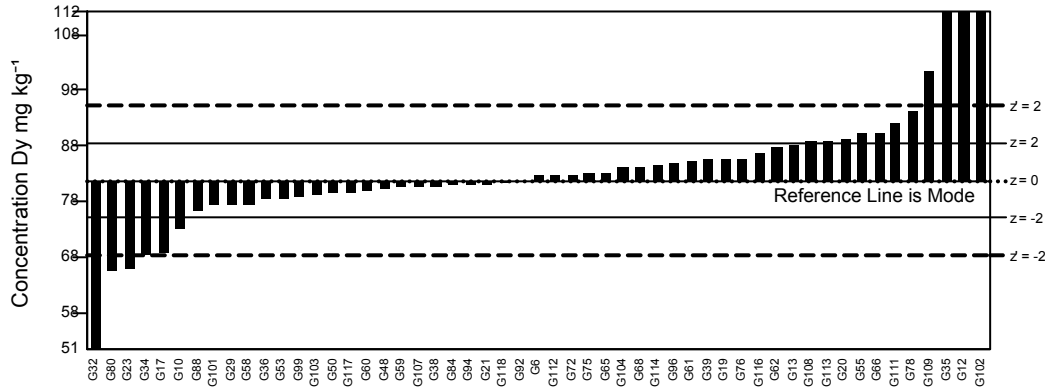
GeoPT46A - Barchart for Cs



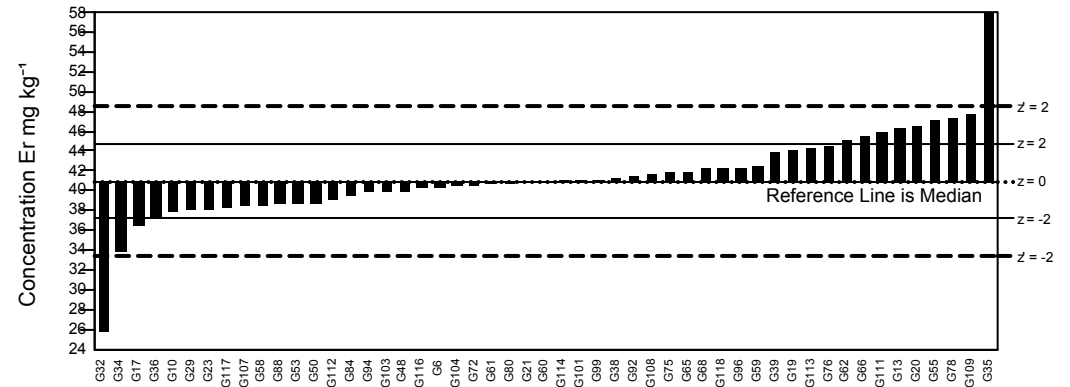
GeoPT46A - Barchart for Cu



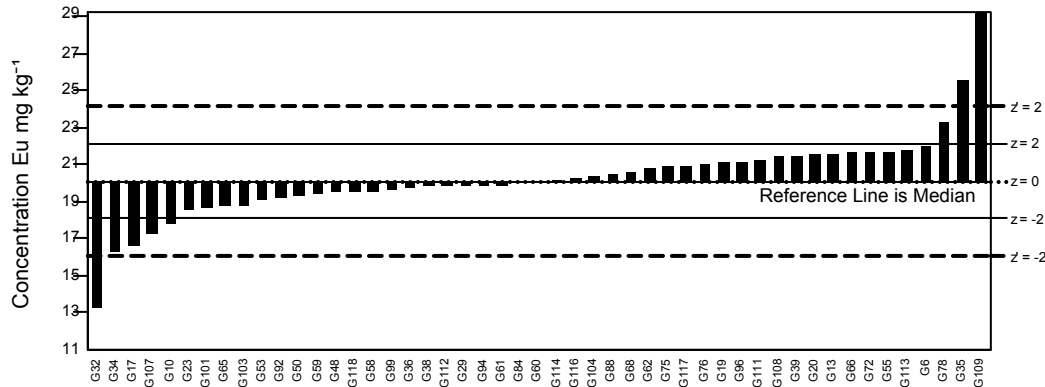
GeoPT46A - Barchart for Dy



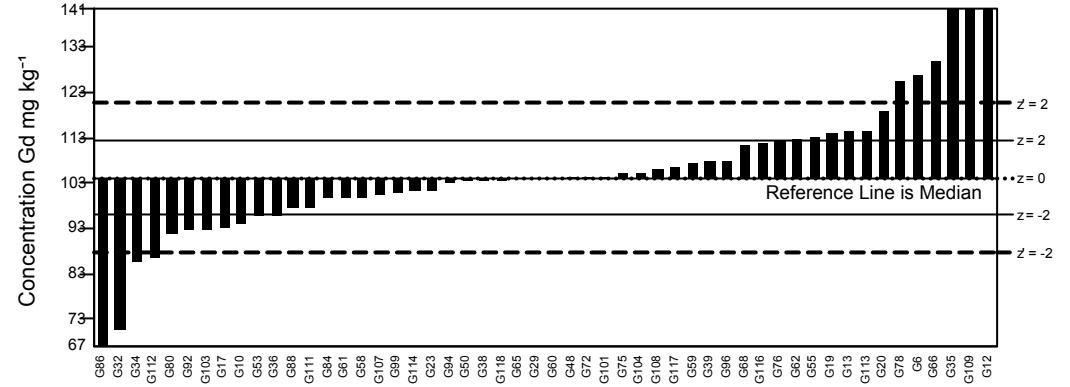
GeoPT46A - Barchart for Er



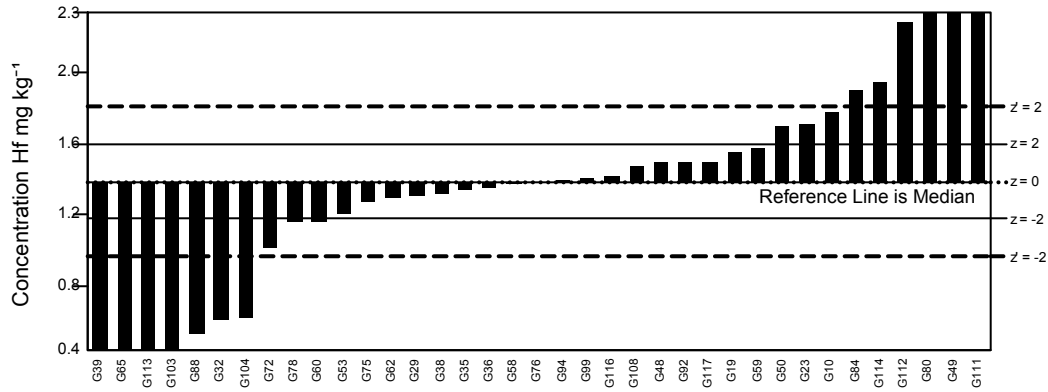
GeoPT46A - Barchart for Eu



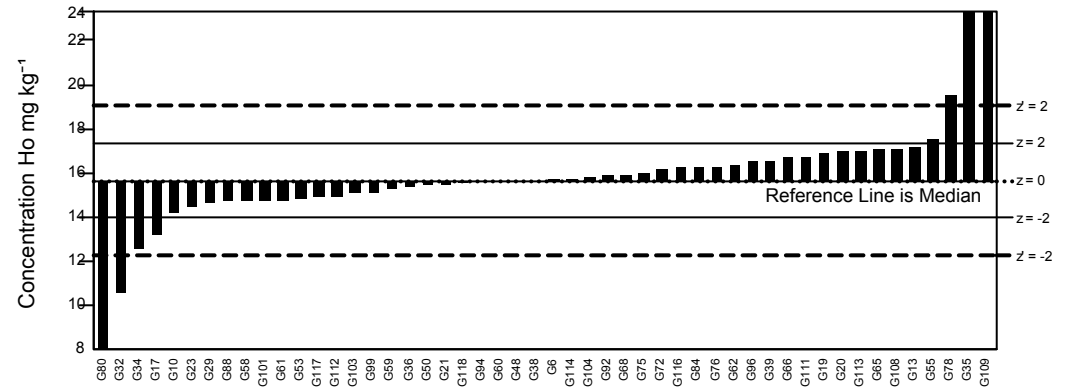
GeoPT46A - Barchart for Gd



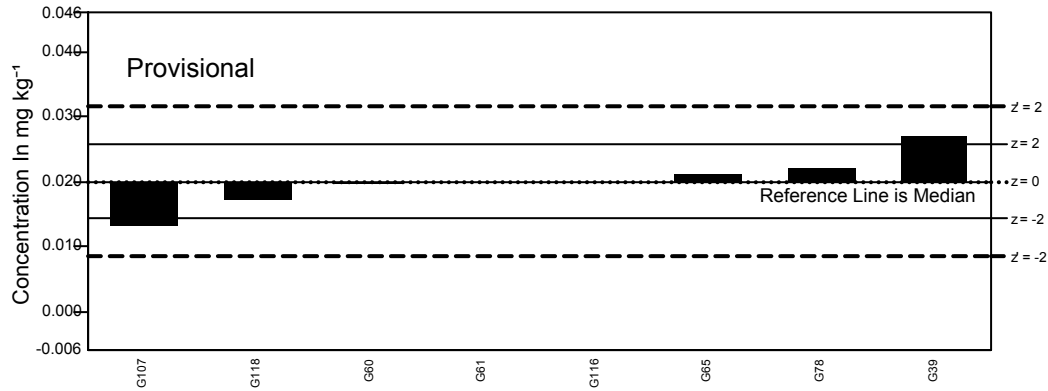
GeoPT46A - Barchart for Hf



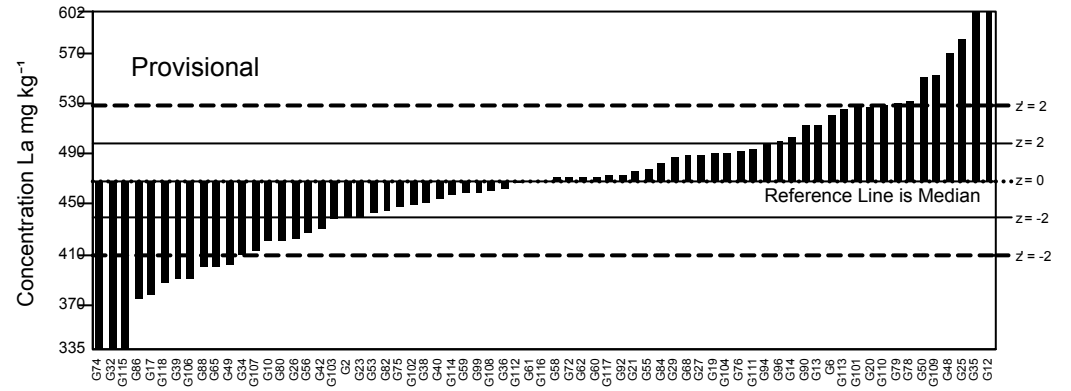
GeoPT46A - Barchart for Ho



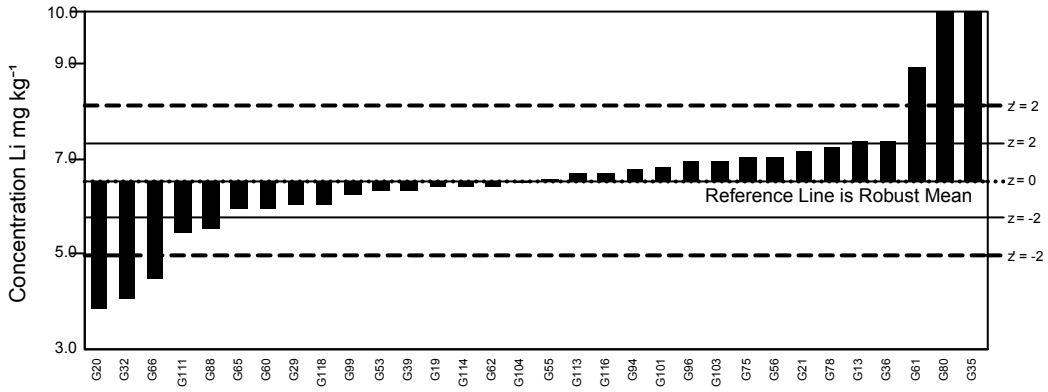
GeoPT46A - Barchart for In



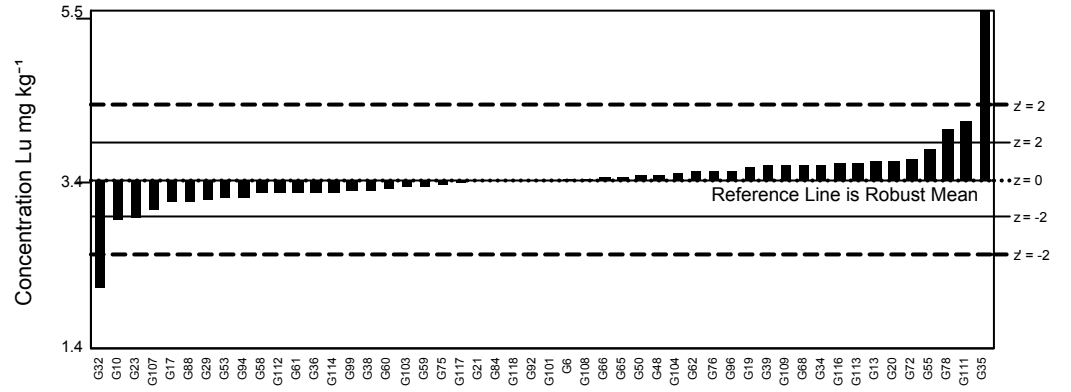
GeoPT46A - Barchart for La



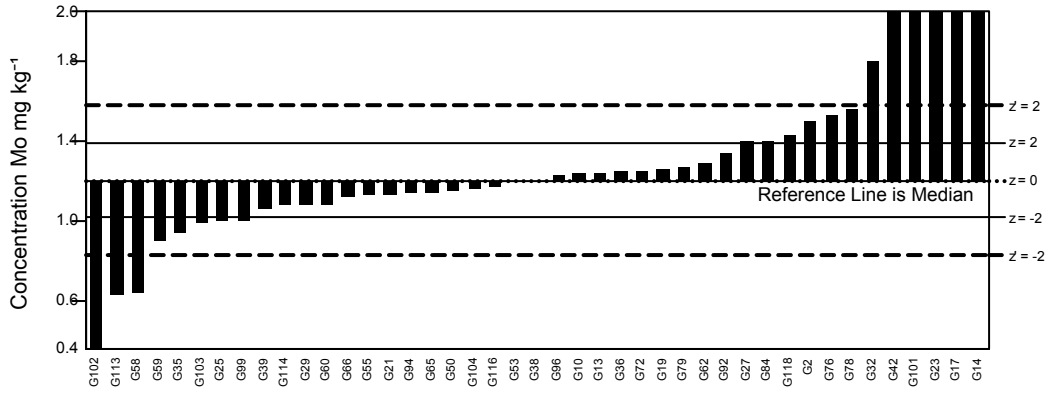
GeoPT46A - Barchart for Li



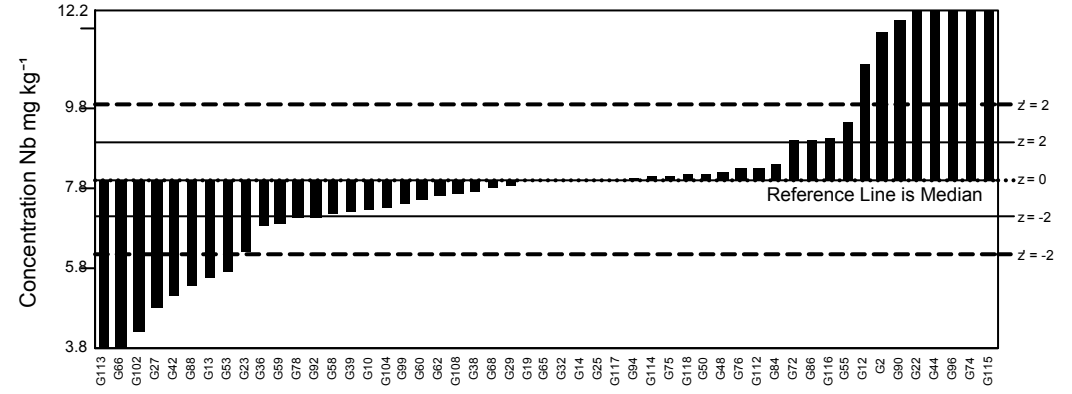
GeoPT46A - Barchart for Lu



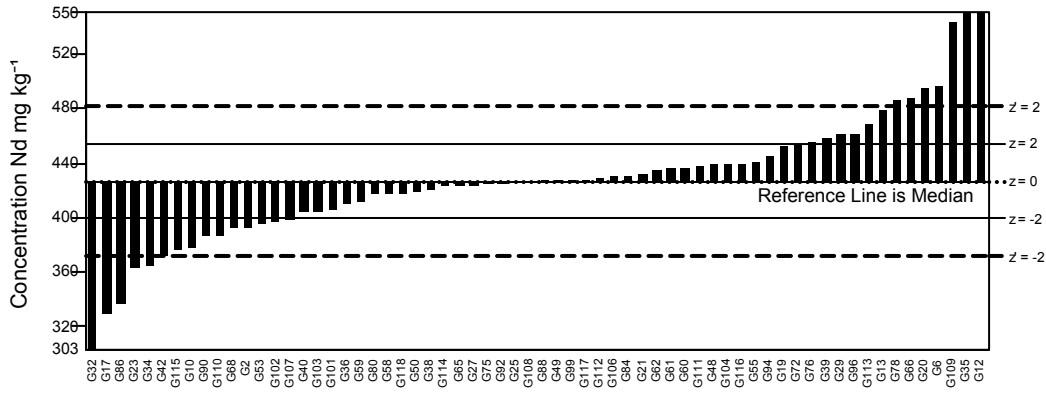
GeoPT46A - Barchart for Mo



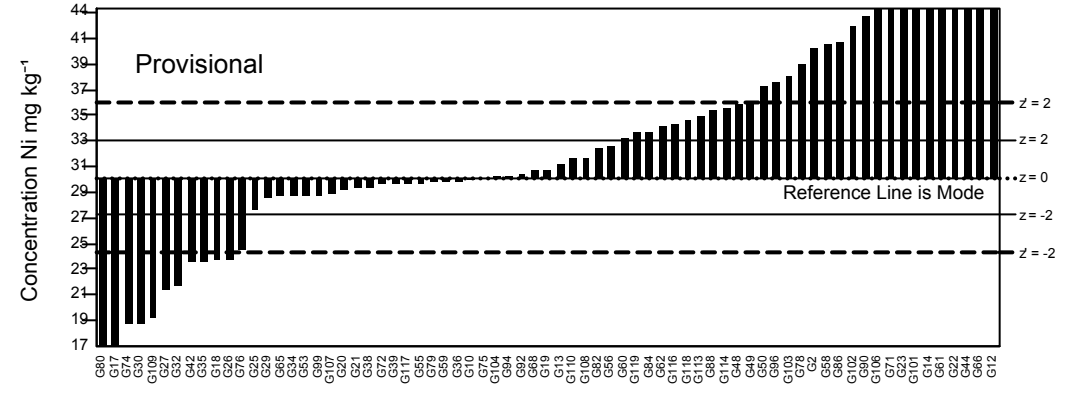
GeoPT46A - Barchart for Nb



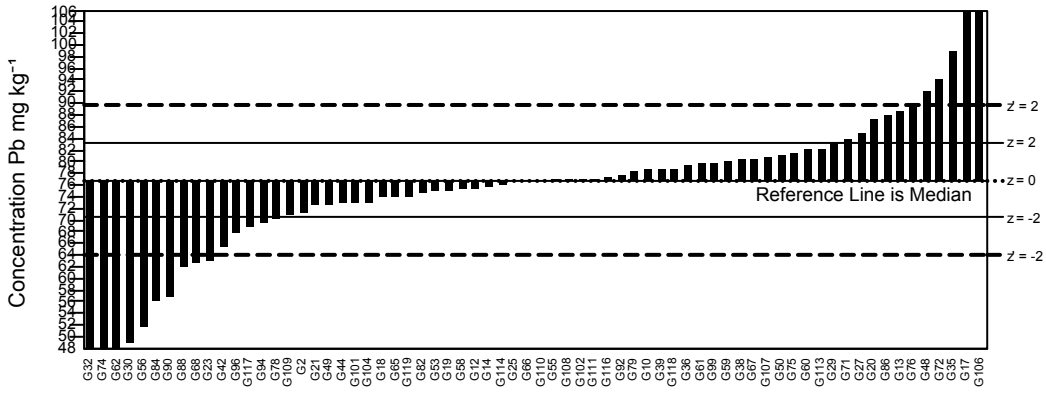
GeoPT46A - Barchart for Nd



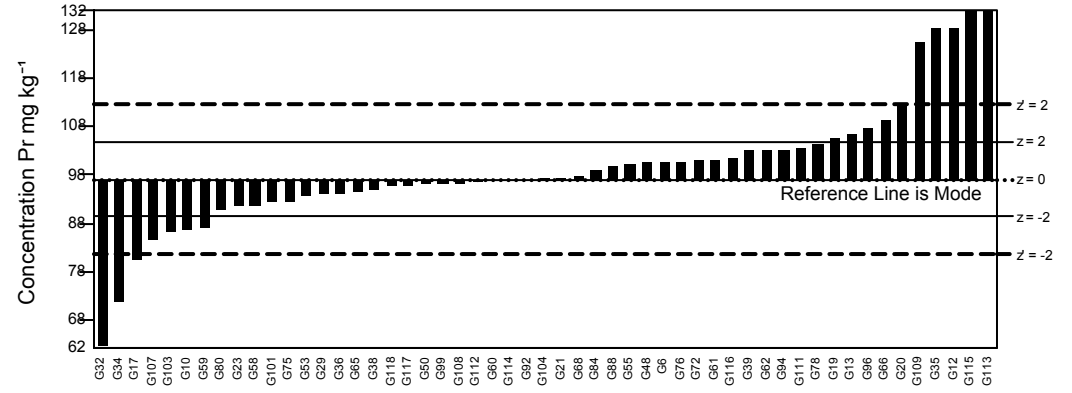
GeoPT46A - Barchart for Ni



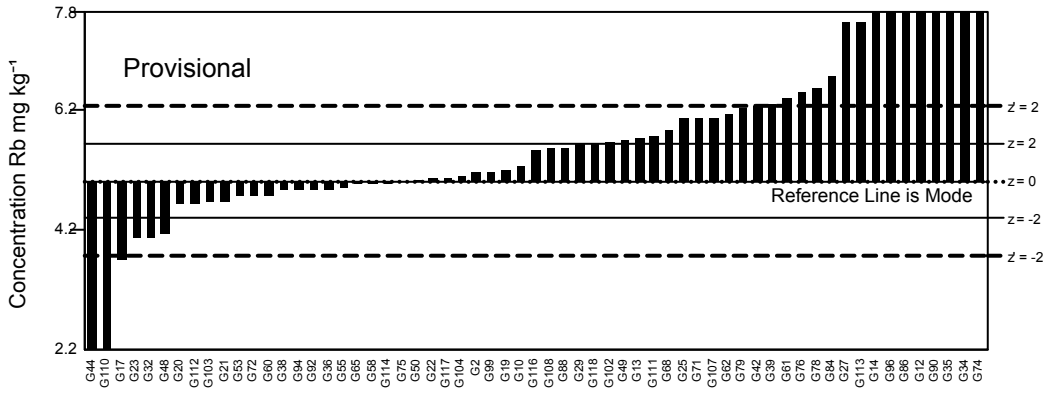
GeoPT46A - Barchart for Pb



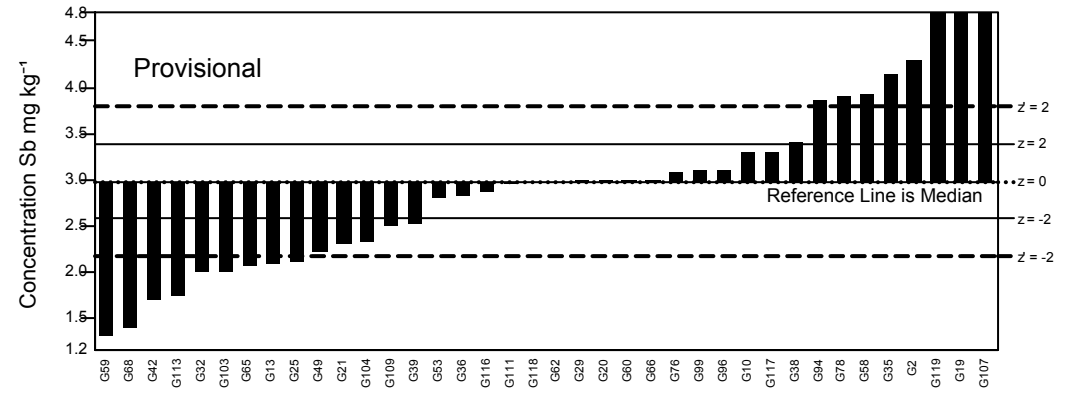
GeoPT46A - Barchart for Pr



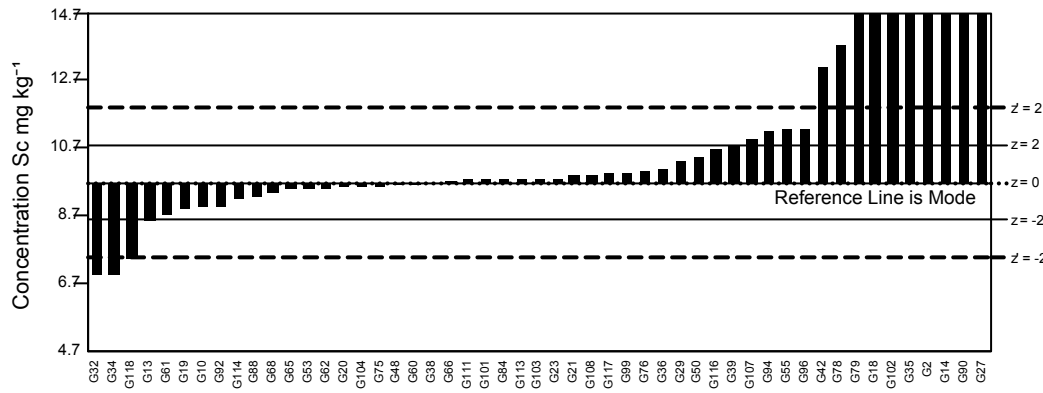
GeoPT46A - Barchart for Rb



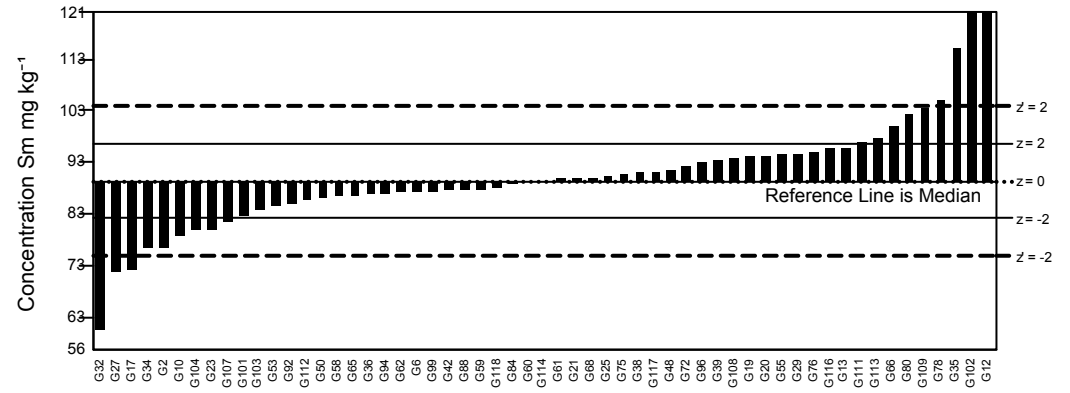
GeoPT46A - Barchart for Sb



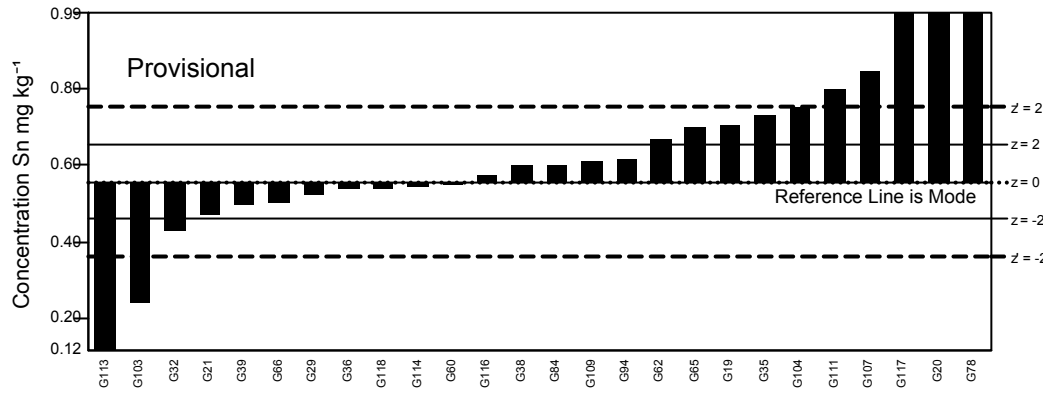
GeoPT46A - Barchart for Sc



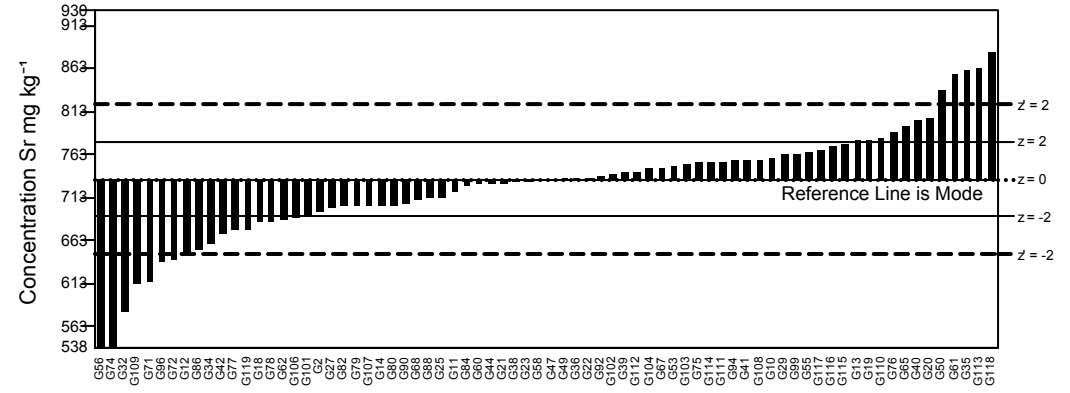
GeoPT46A - Barchart for Sm



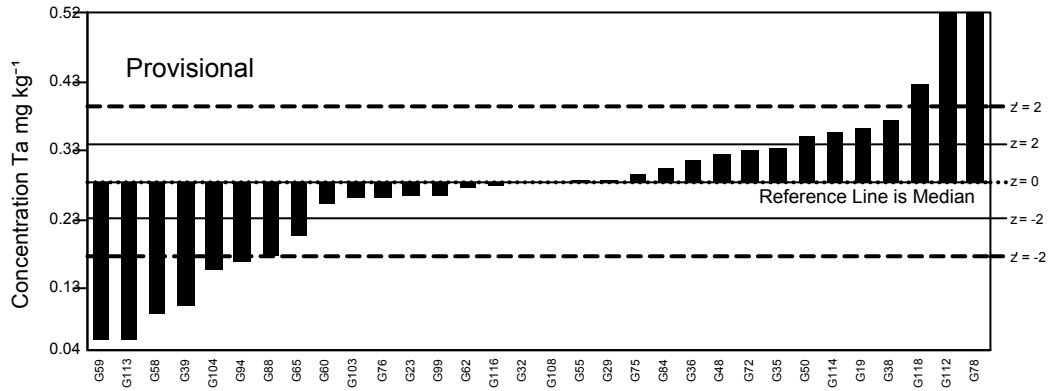
GeoPT46A - Barchart for Sn



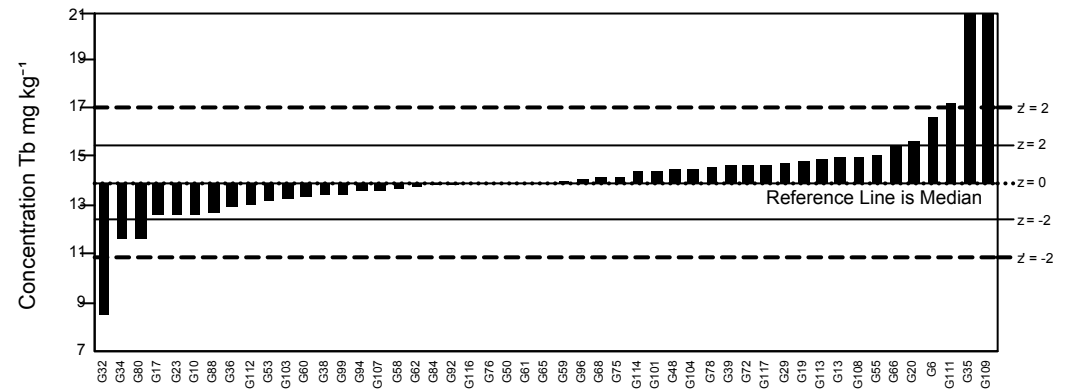
GeoPT46A - Barchart for Sr



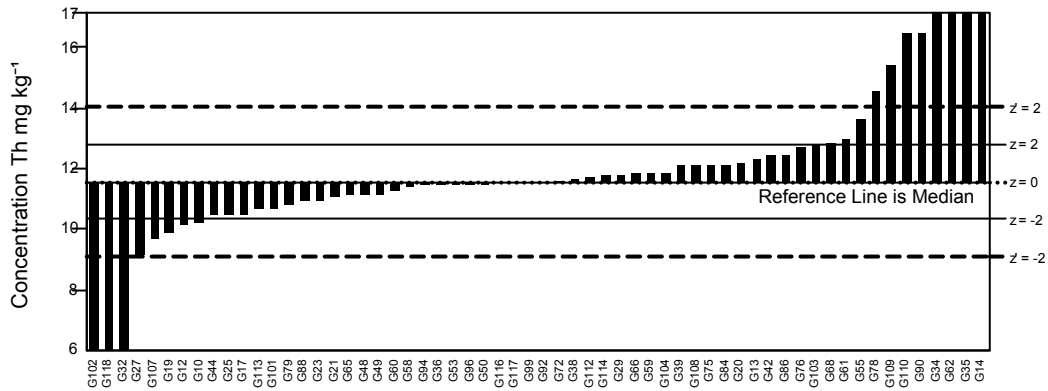
GeoPT46A - Barchart for Ta



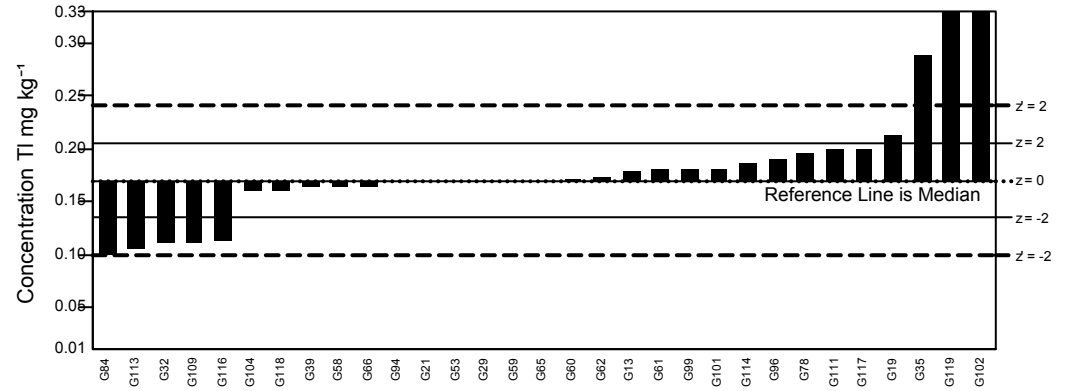
GeoPT46A - Barchart for Tb



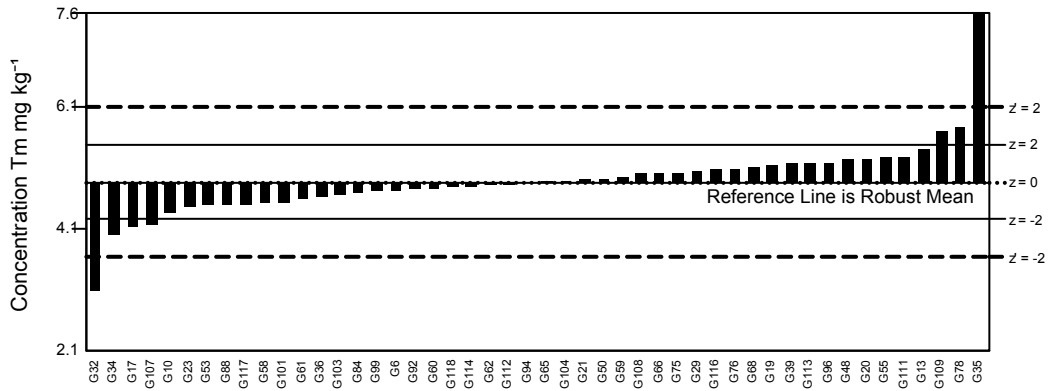
GeoPT46A - Barchart for Th



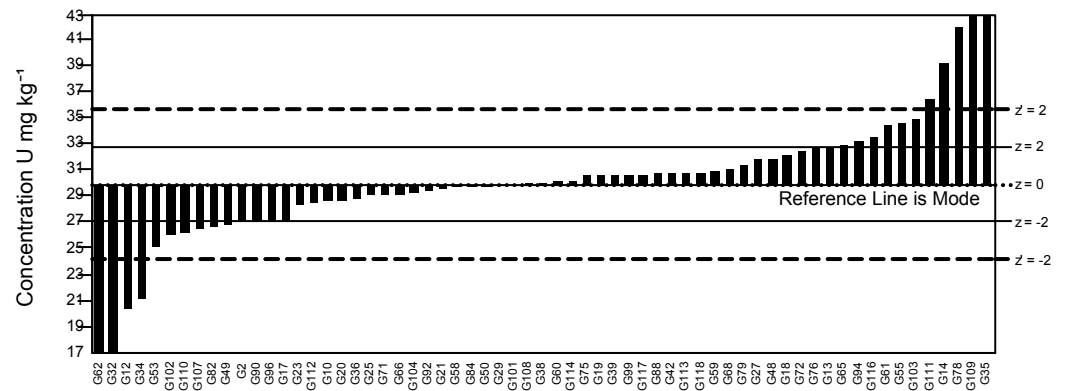
GeoPT46A - Barchart for TI



GeoPT46A - Barchart for Tm



GeoPT46A - Barchart for U





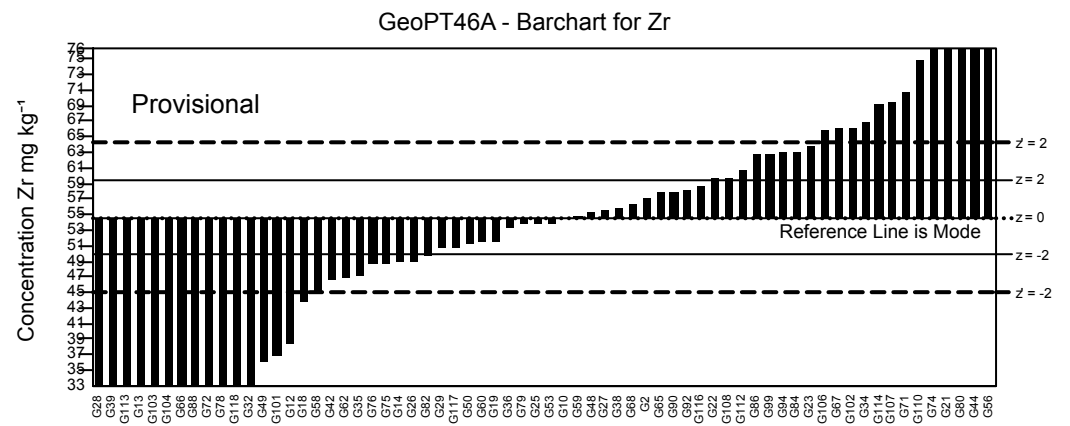
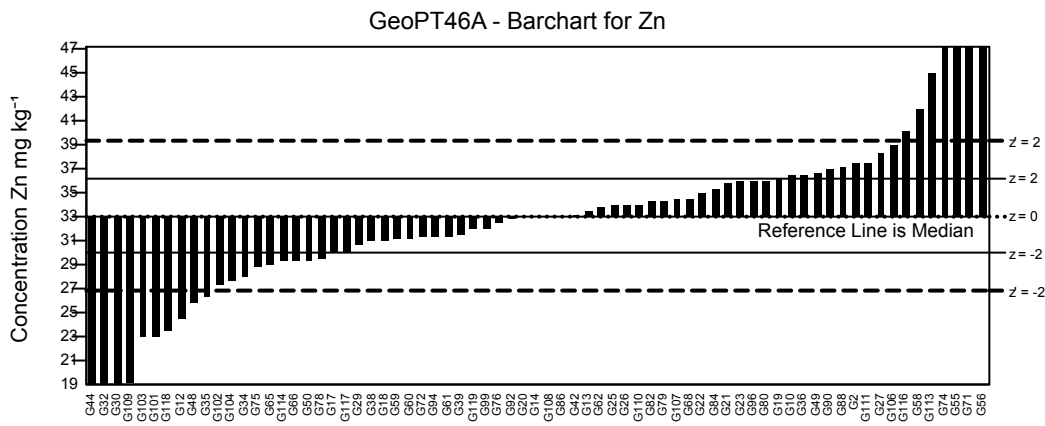
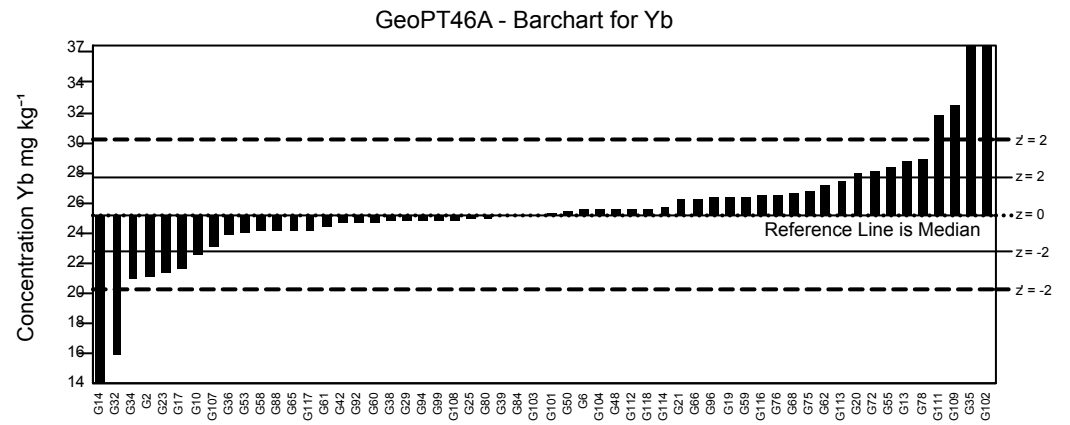
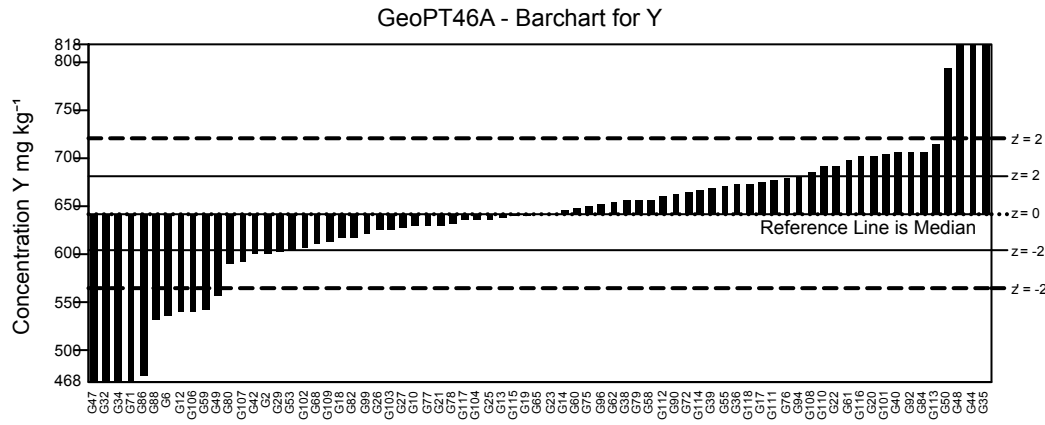
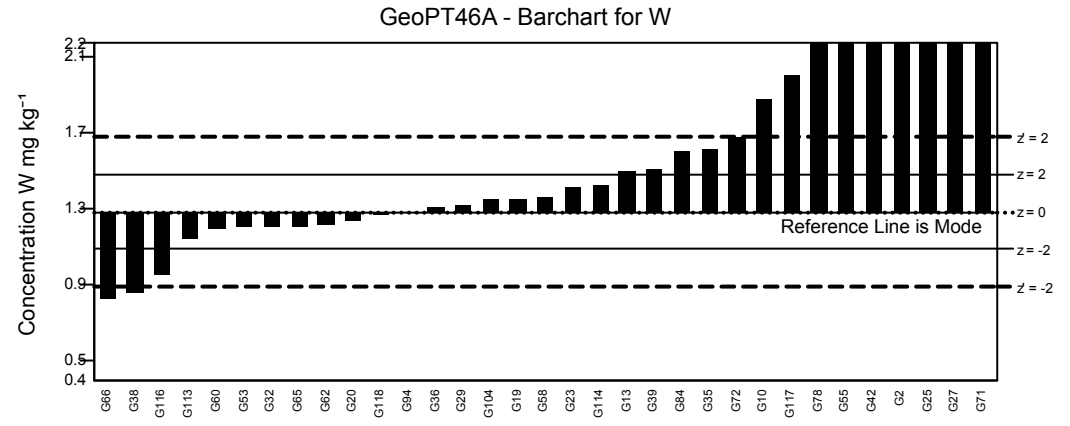
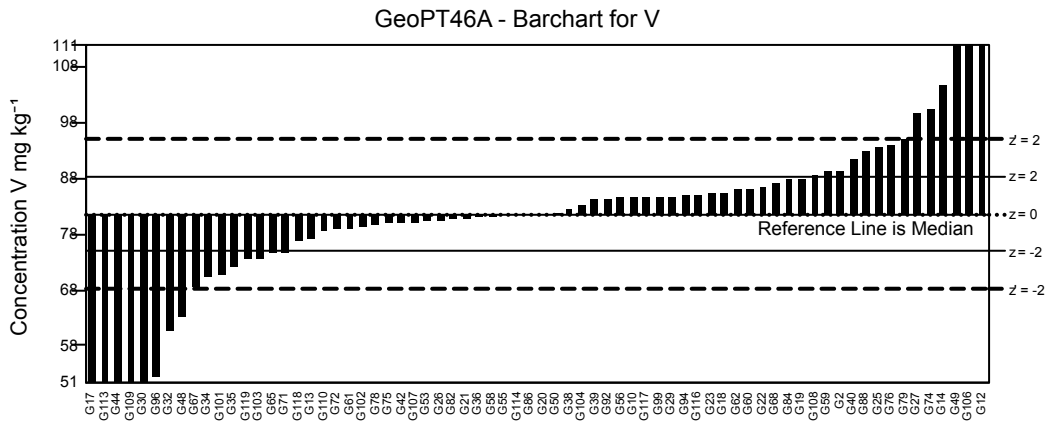
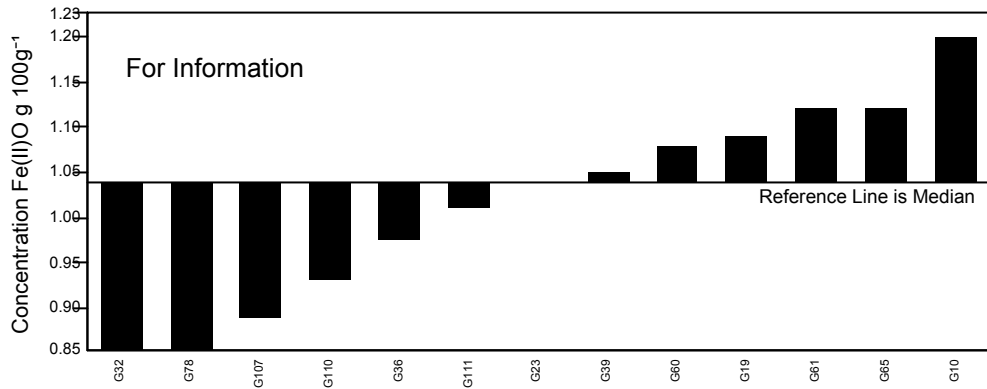
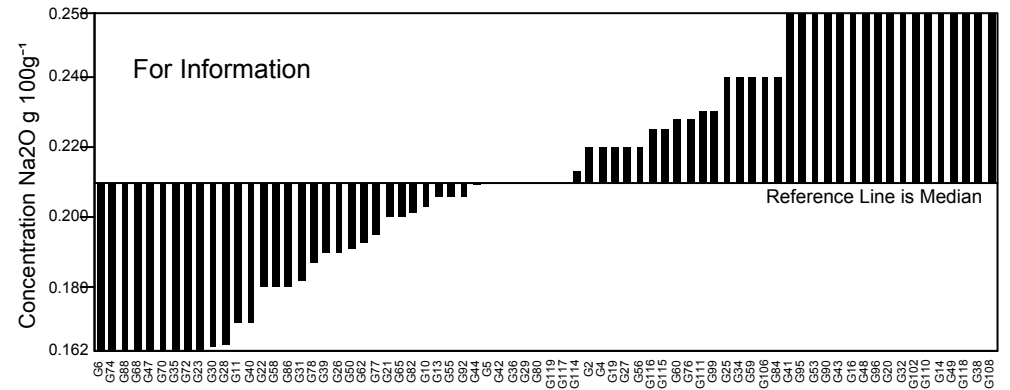


Figure 1: GeoPT46A - Phosphate rock, POLC-1. Data distribution charts for elements for which values were assigned or provisional values given for guidance. Horizontal lines show the limits for  $-2 < z < 2$  for pure geochemistry labs (solid lines) and  $-2 < z < 2$  for applied geochemistry labs (pecked lines).

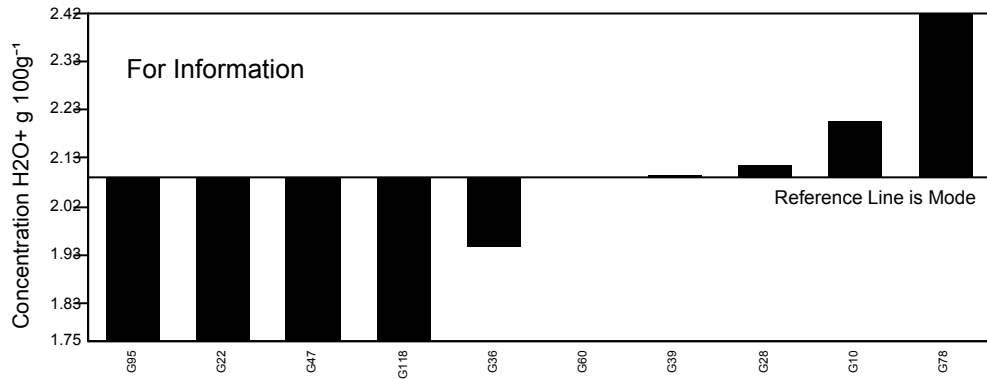
GeoPT46A - Barchart for Fe(II)O



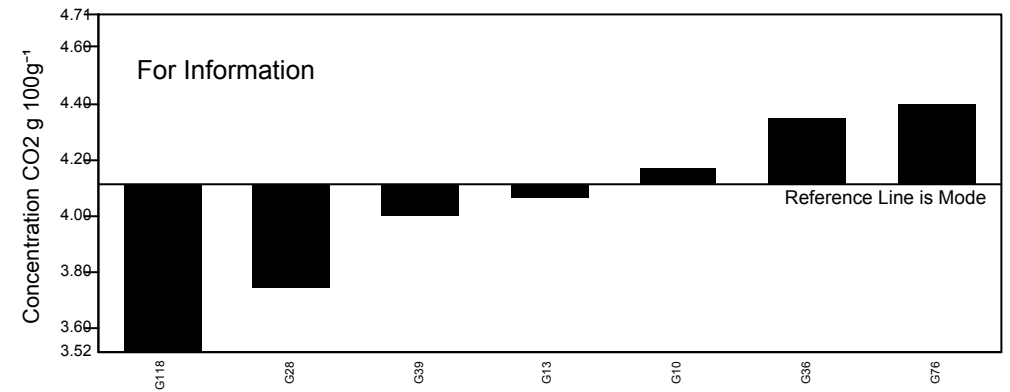
GeoPT46A - Barchart for Na2O



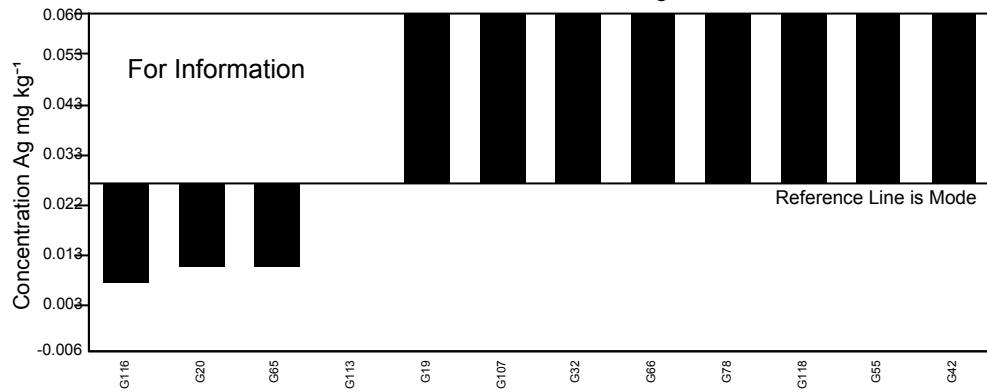
GeoPT46A - Barchart for H2O+



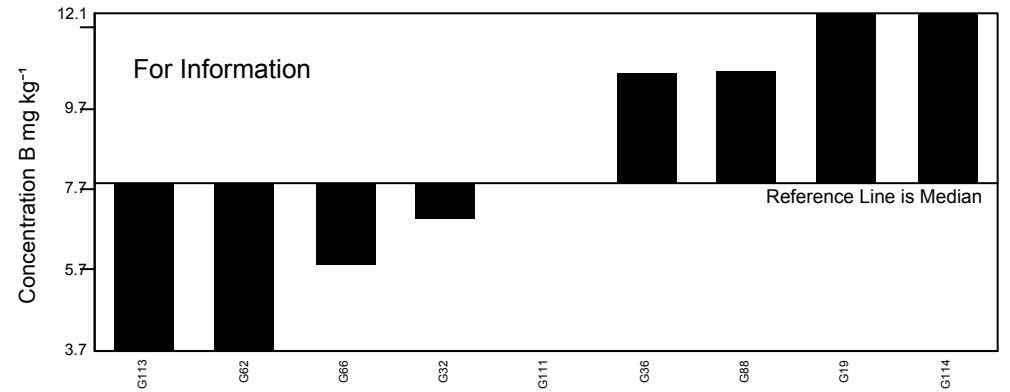
GeoPT46A - Barchart for CO2

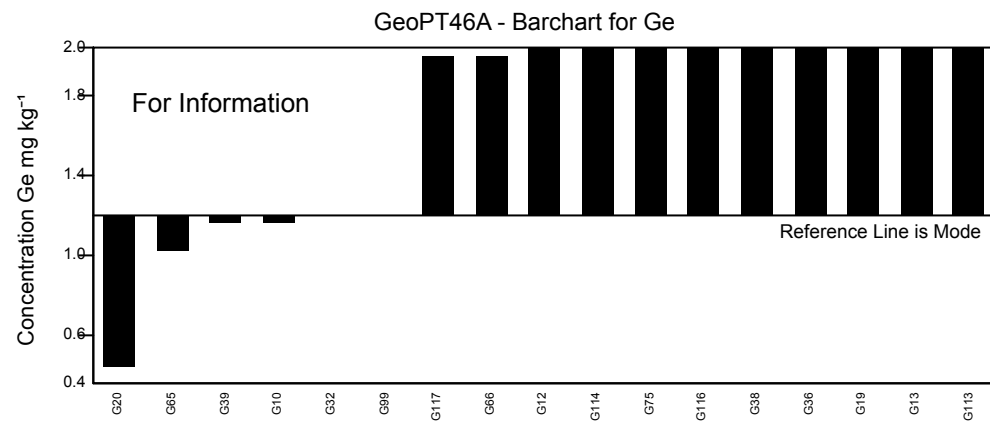
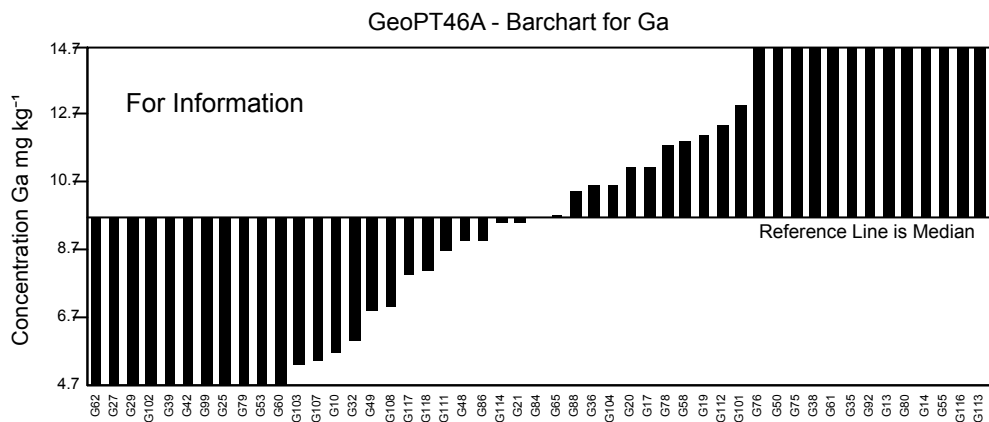
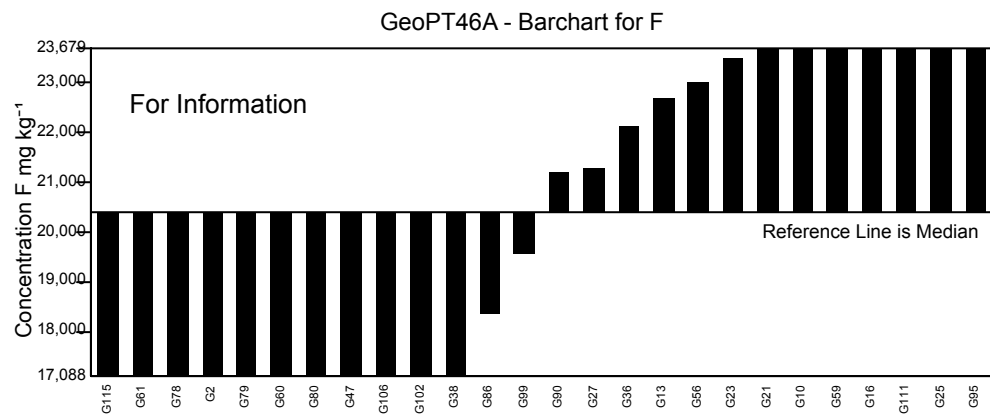
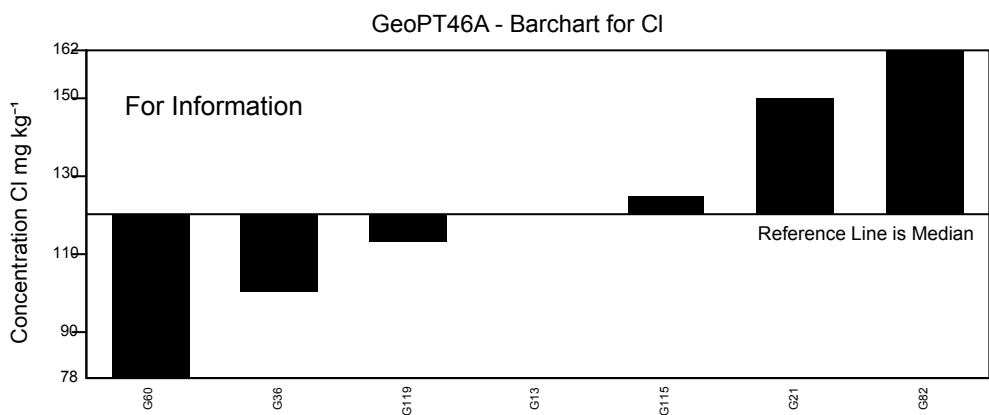
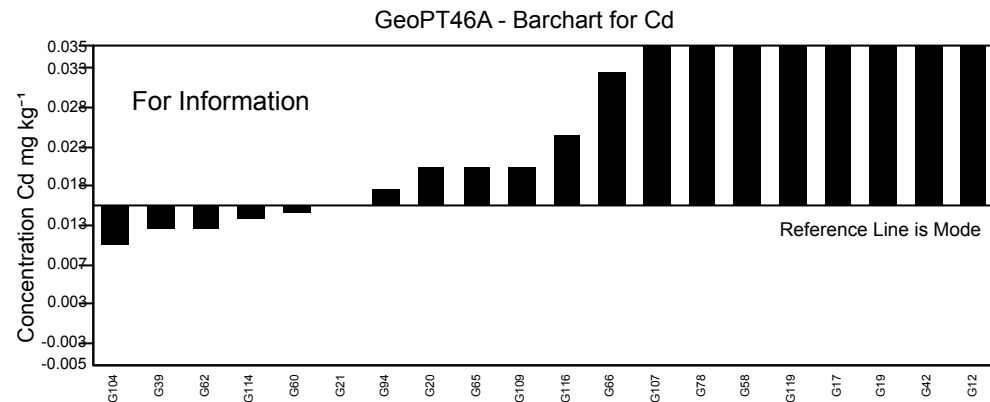
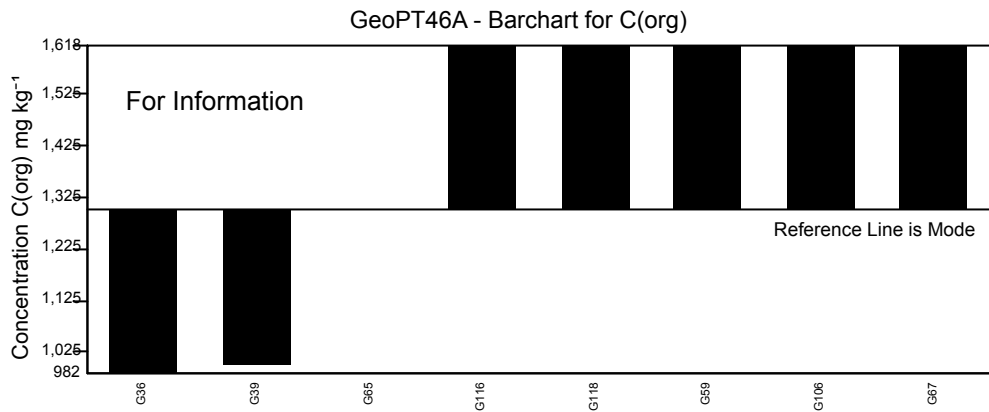


GeoPT46A - Barchart for Ag



GeoPT46A - Barchart for B





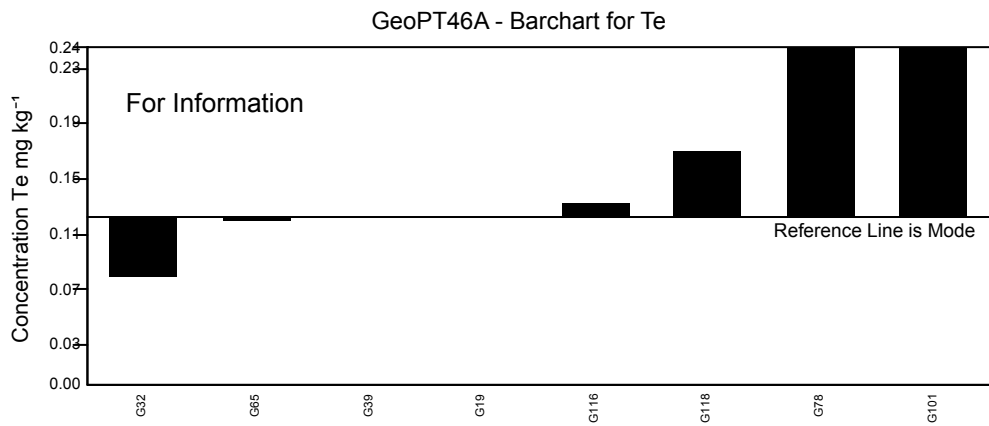
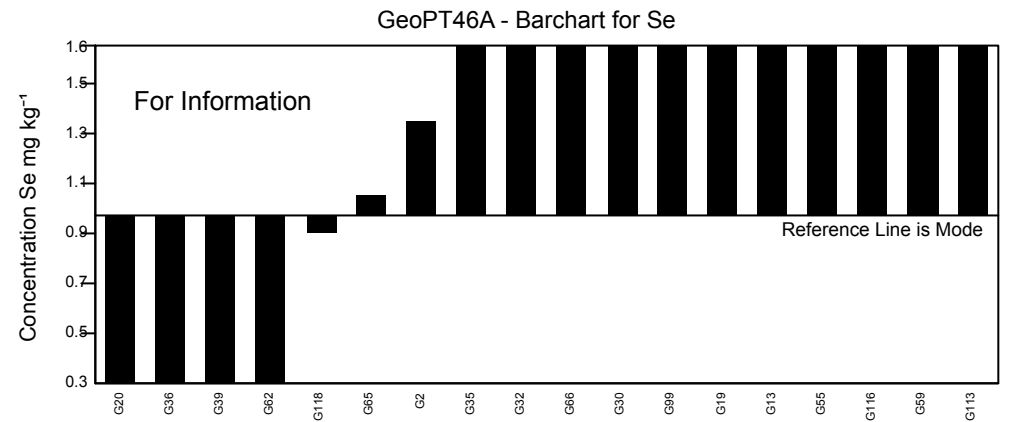
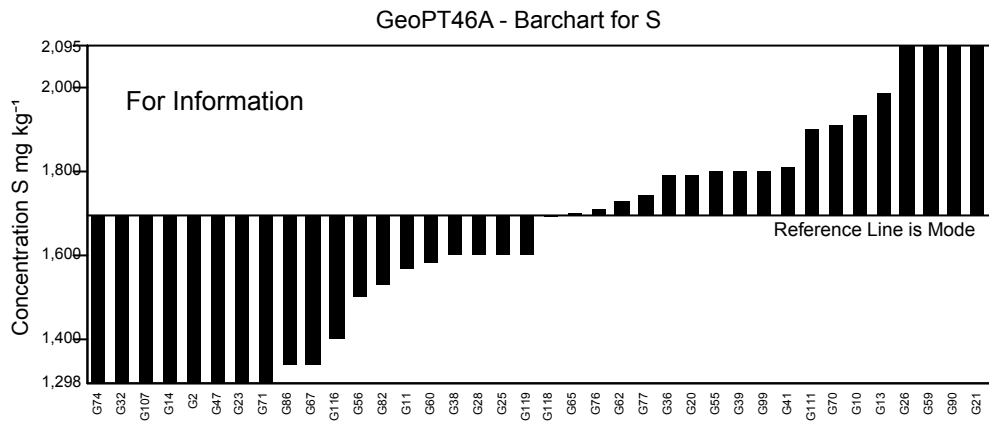
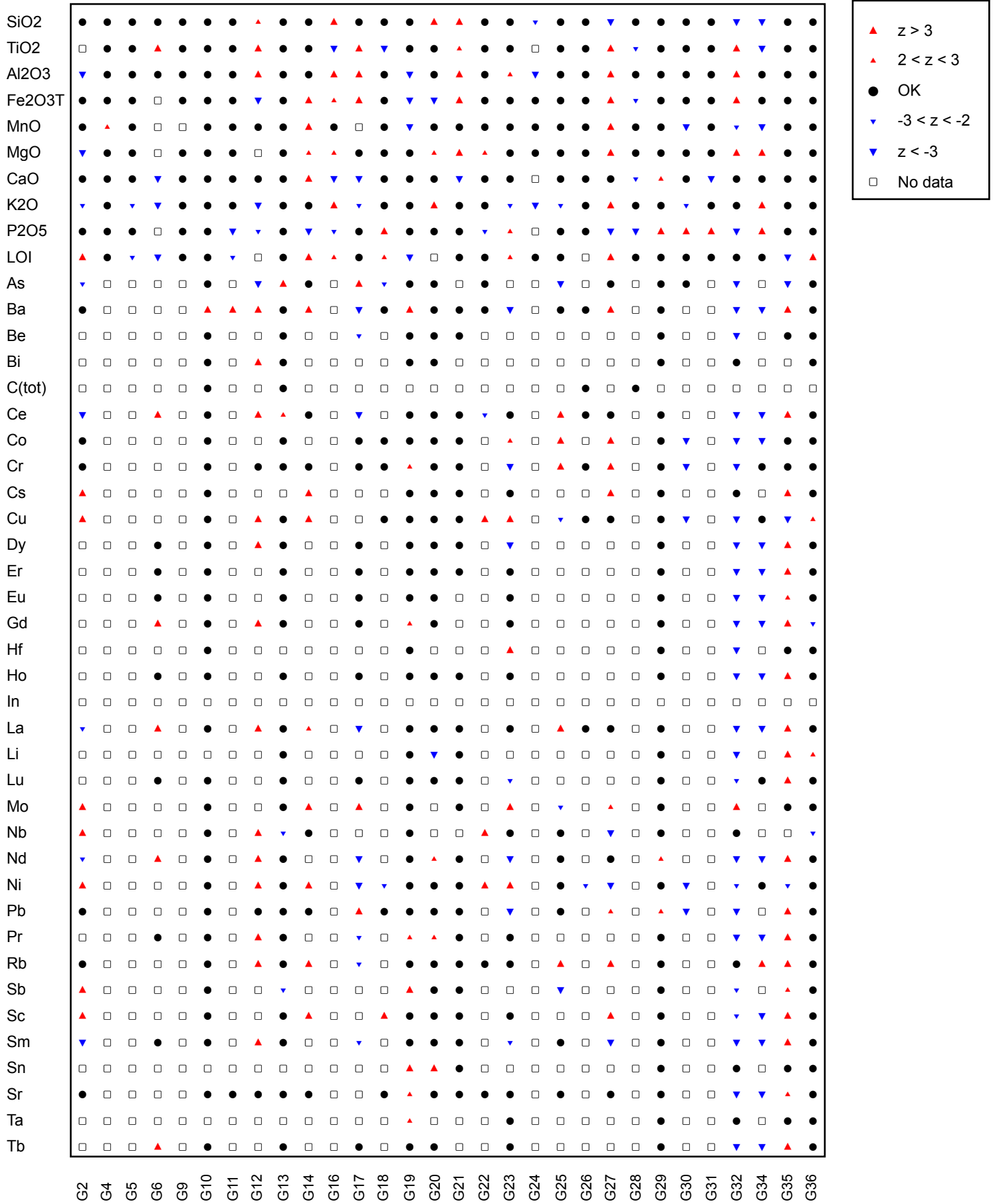


Figure 2: GeoPT46A - Phosphate rock, POLC-1. Data distribution charts provided for information only for elements for which values could not be assigned.

Multiple Z-Score Chart for GeoPT46A



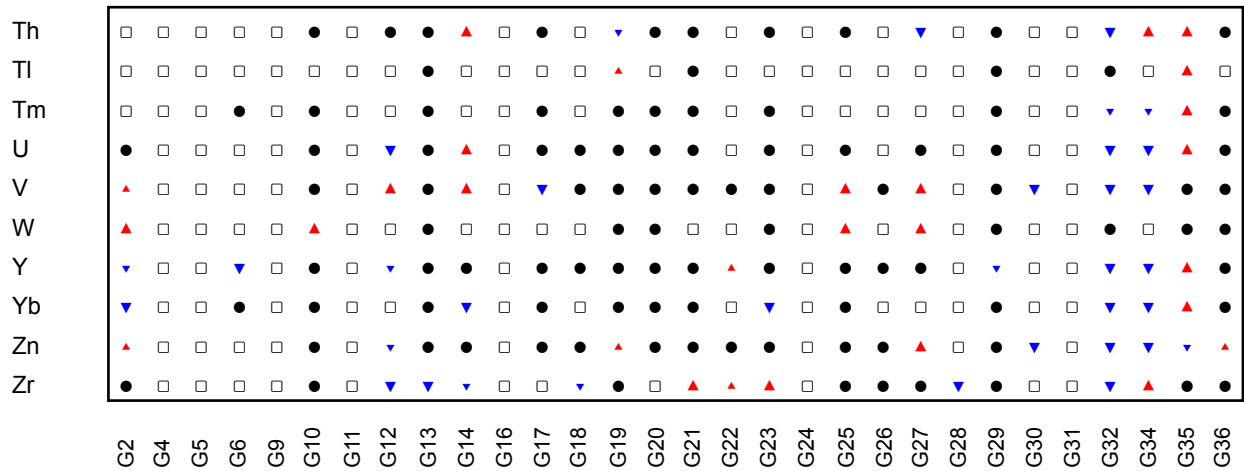


Figure 3: GeoPT46A - Phosphate rock, POLC-1. Multiple z-score charts for laboratories participating in the GeoPT46 A round. Symbols indicate whether or not an elemental result complies with the  $-2 < z < +2$  criteria (see key).



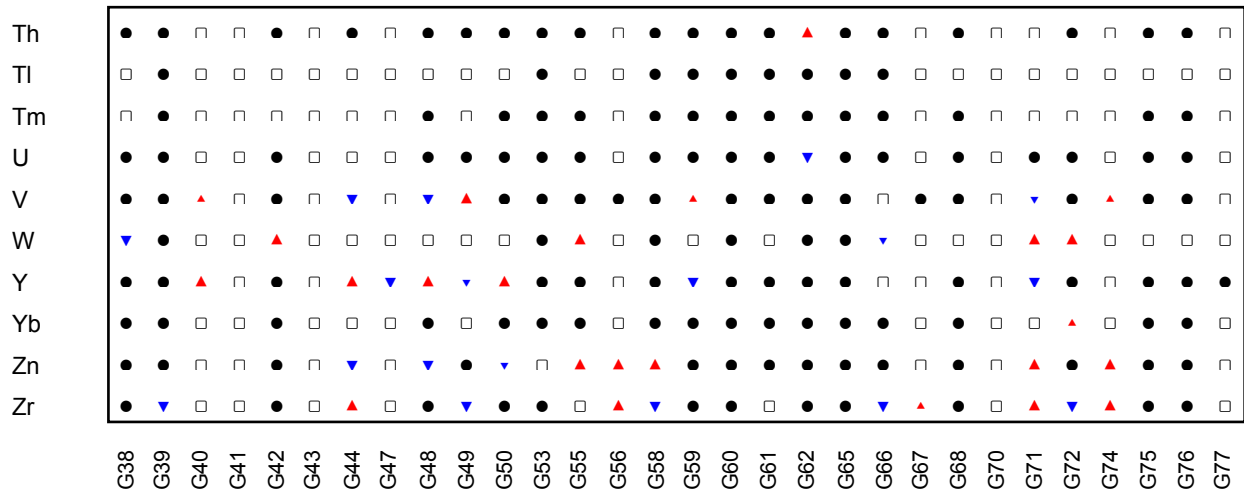
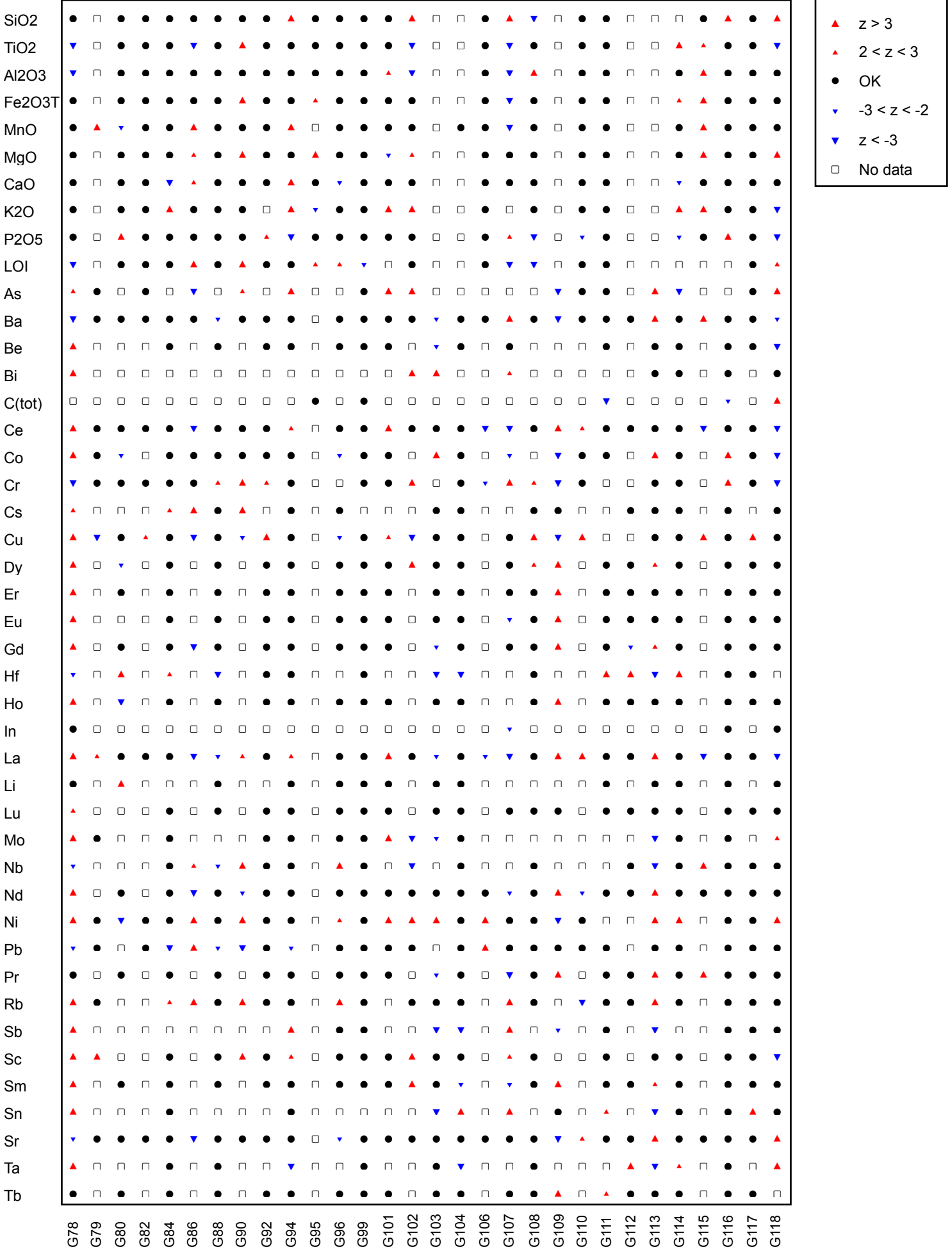


Figure 3: GeoPT46A - Phosphate rock, POLC-1. Multiple z-score charts for laboratories participating in the GeoPT46 A round. Symbols indicate whether or not an elemental result complies with the  $-2 < z < +2$  criteria (see key).



Multiple Z-Score Chart for GeoPT46A



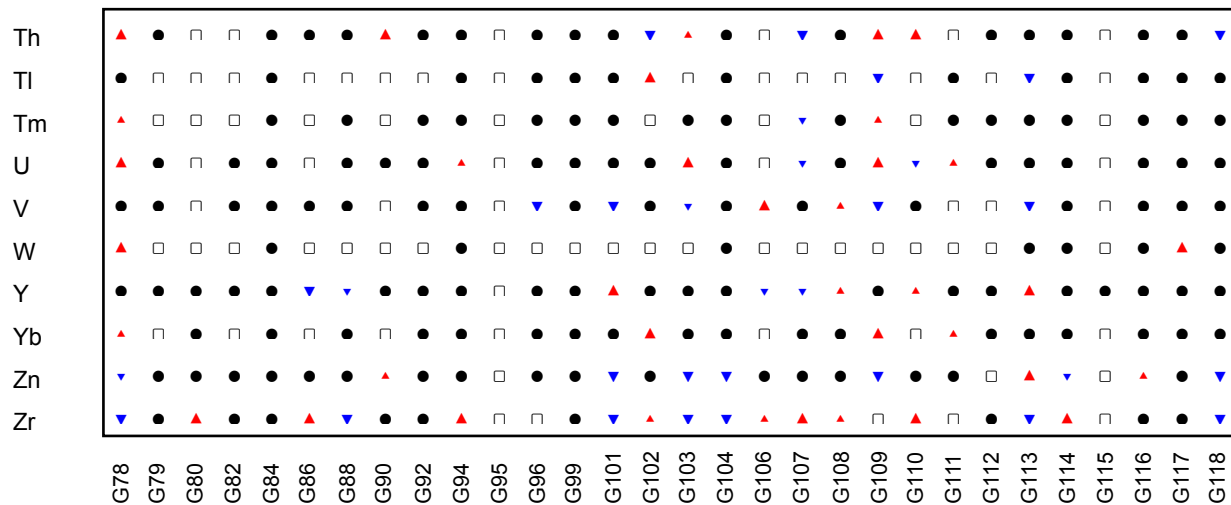


Figure 3: GeoPT46A - Phosphate rock, POLC-1. Multiple z-score charts for laboratories participating in the GeoPT46 A round. Symbols indicate whether or not an elemental result complies with the  $-2 < z < +2$  criteria (see key).

Multiple Z-Score Chart for GeoPT46A

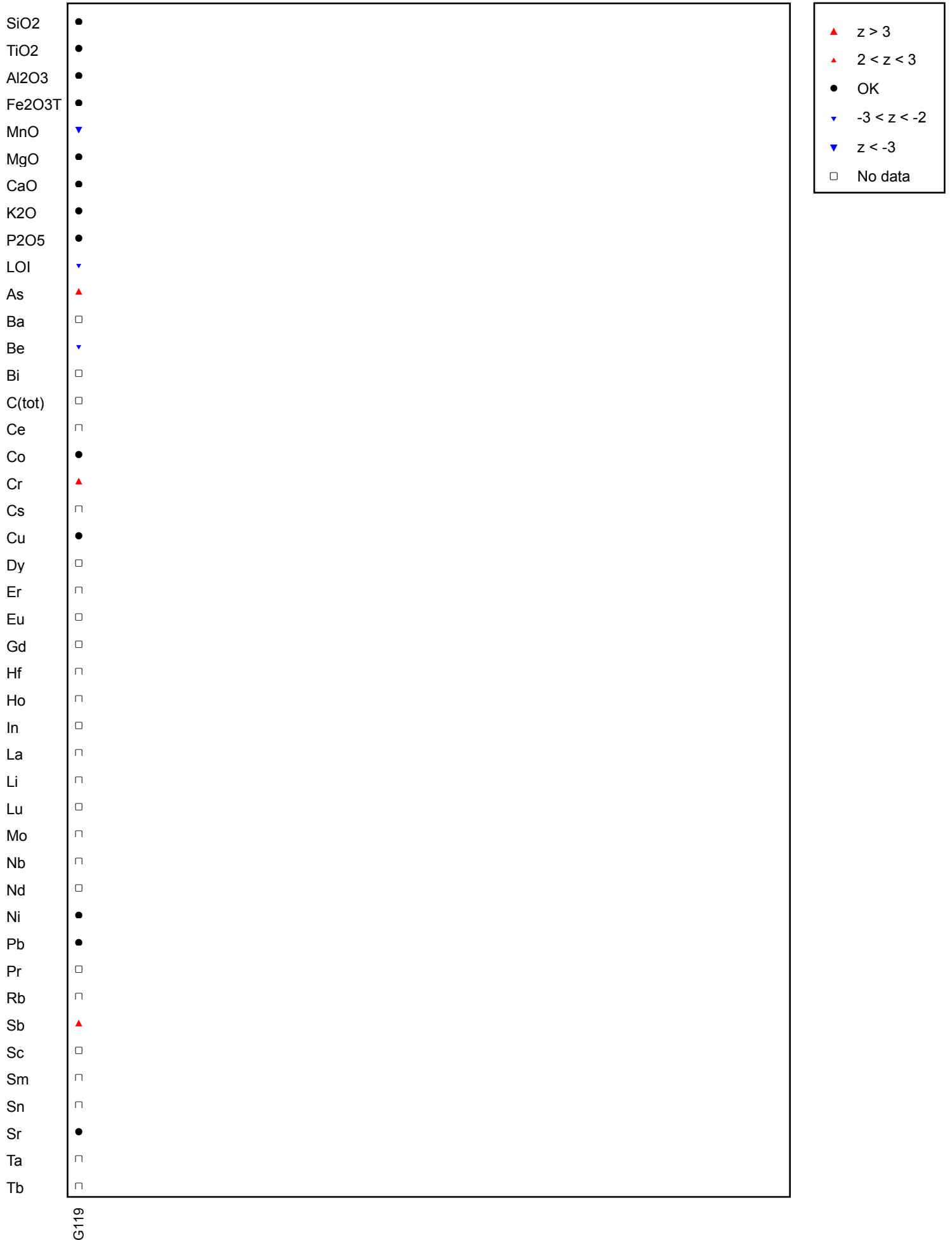




Figure 3: GeoPT46A - Phosphate rock, POLC-1. Multiple z-score charts for laboratories participating in the GeoPT46 A round. Symbols indicate whether or not an elemental result complies with the  $-2 < z < +2$  criteria (see key).