

GEOCHEMICAL PROFICIENCY TESTING PROGRAM

ROUND 14

MARCH 2019

REPORT NO. 1130

ACKNOWLEDGMENTS

PTA wishes to gratefully acknowledge the technical assistance that was provided for this program by Ms J Hwende, Bureau Veritas Australia Pty Ltd.

© **COPYRIGHT PROFICIENCY TESTING AUSTRALIA 2019**
PO Box 1122, Archerfield BC, QLD, 4108, Australia

CONTENTS

1. Foreword	1
2. Program Features and Design	1
3. Statistical Format	2
4. PTA and Technical Adviser's comments	5
5. Outlier Results	7
6. References	7

APPENDIX A – Results and Data Analysis

Aluminium	A1.1
Arsenic	A2.1
Calcium	A3.1
Copper	A4.1
Iron	A5.1
Magnesium	A6.1
Manganese	A7.1
Phosphorous	A8.1
Potassium	A9.1
Silicon	A10.1
Sodium	A11.1
Sulphur	A12.1
Titanium	A13.1
Loss on Ignition	A14.1

APPENDIX B – Sample Homogeneity

Homogeneity Testing and Stability	B1
-----------------------------------	----

APPENDIX C – Documentation

Instructions to Participants	C1
Results Sheet	C4

1. Foreword

This report summarises the results of a proficiency testing program on the analysis of geochemical samples. It constitutes the fourteenth round of an ongoing series of programs in this area. This program is accredited to ISO/IEC 17043:2010 “*Conformity assessment - General requirements for proficiency testing*” by International Accreditation New Zealand (IANZ).

The program was conducted in December 2018 / January 2019 by Proficiency Testing Australia (PTA). The main aim of the program was to assess laboratories’ abilities to competently perform the prescribed analyses.

The Program Coordinator was Mrs K Weller and the Technical Adviser was Ms J Hwende, Bureau Veritas Australia Pty Ltd. This report was authorised by Mrs K Cividin, PTA Quality Manager.

2. Program Features and Design

- 2.1 Each laboratory was randomly allocated a unique code number for the program to ensure confidentiality of results. Reference to each laboratory in this report is by code number only.
- 2.2 Participants were provided with one Iron Ore sample.
- 2.3 Laboratories were provided with the "Instructions to Participants" and "Results Sheet" (see Appendix C) and asked to report total analysis of the elements listed below:

Aluminium	Al	Magnesium	Mg	Sodium	Na
Arsenic	As	Manganese	Mn	Sulphur	S
Calcium	Ca	Phosphorous	P	Titanium	Ti
Copper	Cu	Potassium	K	Loss on Ignition	LOI
Iron	Fe	Silicon	Si		

- 2.4 A total of 5 laboratories participated in the program with 4 laboratories returning results for inclusion in the final report.

All participant laboratories were from Australia.

- 2.5 Results (as reported by participants), and where relevant, corresponding summary statistics (i.e. number of results, assigned value, standard deviation, coefficient of variation, minimum, maximum, range and uncertainty of the assigned value are presented in Appendix A.
- 2.6 A robust statistical approach, using z-scores, was utilised to assess laboratories’ testing performance (see Section 3). Robust z-scores and z-score charts, where relevant to each test, are presented in Appendix A.

The document entitled *Guide to Proficiency Testing Australia, 2016* (reference [1]) defines the statistical terms and details the statistical procedures referred to in this report.

- 2.7 Samples dispatched for this round were Standards Australia certified reference material ASCRM-035 Iron Ore (Yilgarn Hematite) and therefore are considered homogeneous and stable for the duration of the round. To confirm homogeneity, three randomly selected samples were analysed by Bureau Veritas Pty Ltd (SA) (See Appendix B). As such, any results later identified as outliers could not be attributed to any notable sample variability.

3. Statistical Format

For each test the following information is given, where appropriate:

- a table of results and calculated z-scores;
- a list of summary statistics; and
- ordered z-score charts.

3.1 Outlier Results and Z-scores

In order to assess laboratories' testing performance, a robust statistical approach, using z-scores, was utilised. Z-scores give a measure of how far a result is from the consensus value (i.e. the median), and gives a "score" to each result relative to the other results in the group.

A z-score close to zero indicates that the result agrees well with those from other laboratories, whereas a z-score with an absolute value greater than or equal to 3.0 is considered to be an outlier and is marked by the symbol "§".

Where relevant, each determination was examined for outliers with all methods pooled. Table B on page 7 summarises the outlier results detected.

3.2 Results Tables and Summary Statistics

Each of these tables contains the results returned by each laboratory and where appropriate, the robust z-score calculated for each result.

Results have been entered exactly as reported by participants. That is, laboratories which did not report results to the precision (i.e. number of significant figures) requested on the Results Sheet have not been rounded to the requested precision before being included in the statistical analysis.

Where relevant, a list of summary statistics appears at the bottom of each of the tables of results and consists of:

- the number of results for that test/sample (*No. of Results*);
- the assigned value (based on the reference material);
- the uncertainty of the assigned value (based on the reference material);
- the standard deviation (based on the reference material);
- the coefficient of variation, expressed as a percentage (*CV*) - i.e. $100 \times \text{standard deviation} / \text{assigned value}$;
- the minimum and maximum laboratory results; and
- the range (*Maximum - Minimum*).

Please see reference [1] for further details on these robust summary statistics.

3.3 Ordered Z-score Charts

On these charts each laboratory's robust z-score is shown, in order of magnitude, and is marked with its code number. From these charts, each laboratory can readily compare its performance relative to the other laboratories.

These charts contain solid lines at +3.0 and -3.0, so that outliers are clearly identifiable as those laboratories whose "bar" extends beyond these "cut-off" lines. The y-axis of these charts has been limited, so very large z-scores appear to extend beyond the chart boundary.

Further details for the interpretation of these diagrams are given in reference [1]. Please also refer to this document for a glossary of terms.

TABLE A: SUMMARY STATISTICS

Analysis	No. of Results	Certified Value (Assigned Value) (%) ¹	Standard Deviation	Uncertainty (Assigned Value) (%)
Aluminium	7	0.72	0.01	0.0010
Arsenic	3	0.0079	0.0029	0.0005
Calcium	6	0.117	0.004	0.0004
Copper ¹	3	0.0087	0.0012	0.0002
Iron	7	62.35	0.39	0.1126
Magnesium	6	0.150	0.011	0.0011
Manganese	6	0.152	0.003	0.0003
Phosphorus ¹	5	0.078	0.002	0.0002
Potassium	6	0.022	0.0026	0.0003
Silicon	7	1.99	0.02	0.002
Sodium	5	0.0565	0.0186	0.0024
Sulphur	6	0.057	0.003	0.0003
Titanium	6	0.046	0.002	0.0002
Loss on Ignition	5	N/A	Not Calculated ²	

Notes:

1. Only a small number of numerical results (<6) were returned for this round, however as the sample used for this round was a certified reference material, assigned values and standard deviations (based on certified values for the reference material) have been used to calculate robust z-scores for each of these elements except for Iron. For Iron, a target CV of 0.6% was used to calculate the standard deviation.
2. Statistical analysis has not been performed on Loss on Ignition results as less than 6 numerical results were returned. The certified value for Loss on Ignition was not used as the method stated in the instructions for this round was different to that used to determine the certified value.

4. PTA and Technical Adviser's Comments

For this program, laboratories were encouraged to use a method that gave the best detection limit for the element. The comments presented in this section are general in nature.

4.1 Overall performance

Due to the low number of participants, comparison of performance between laboratories was not possible. Results obtained for most elements were close enough to the certified value with some outliers contributed to by rounding and detection limit differences. Some common causes of deviation from the expected value are fusion technique, contamination and XRF calibration, especially with the Iron performance. Two laboratories achieved close to the expected value and two laboratories had significant outliers. Sodium outliers are mostly due to either calibration issues or contamination.

4.2 Outliers

Lab Code	Results Reported	No. of Outliers
1	12	6
2	14	1
3	12	0
4	12	3

Laboratories are encouraged to investigate and eliminate the cause of outliers and anomalies.

4.3 Measurement Uncertainty (MU) and Detection Limit

Two laboratories quantified the Measurement Uncertainty (MU) for the testing performed. It is advisable for laboratories to review their process or calculations for suitability if MU is greater than 5% of the result. The two laboratories had different MU quantities and this would be attributed to using different parameters to quantify MU.

4.4 Z-score (Interlaboratory Performance)

Whilst the z-score gives an indication of where each laboratory stands in comparison to others, laboratories with absolute z-scores:

- greater than 2.0 for any element - should review the technique and calibration for that element.
- greater than or equal to 3.0 for any element - should seriously review the method for that element (except in the case of a typographical or calculation error).

4.5 Duplicates

Duplicate testing was generally performed well.

4.6 Technique Bias

All laboratories in this round used a lithium borate fusion with an XRF finish. Laboratories with outliers are encouraged to investigate the source of error.

4.7 Method Code

All laboratories provided method codes.

4.8 Metrological Traceability and Measurement Uncertainty of Assigned Values

Standards Australia certified reference material ASCRM-035 (Yilgarn Hematite) was used for this program.

The certified values provided with the reference material were used.

4.9 Analysis of Results by Method Groups

In order for methods to be grouped for analysis, PTA requires at least 11 sets of results from the same method group. As there were less than 11 results submitted for each method, reliable conclusions cannot be drawn from analysing grouped methods on this occasion. Therefore, results from all method groups have been pooled for analysis.

5. Outlier Results

Laboratories reporting outlier results are listed in the following table:

TABLE B: OUTLIER RESULTS

Element	Lab Code	Bias	Method Code	Dissolution/Digestion Technique
Aluminium	1	+ve	6 - XRF	Not reported
Arsenic	No outliers reported			
Calcium	4	+ve	6 - XRF	Fusion using Borate Flux
Copper	No outliers reported			
Iron	1	+ve	6 - XRF	Not reported
	4	+ve	6 - XRF	Fusion using Borate Flux
Magnesium	1	+ve	6 - XRF	Not reported
Manganese	4	+ve	6 - XRF	Fusion using Borate Flux
Phosphorous	No outliers reported			
Potassium	1	+ve	6 - XRF	Not reported
Silicon	No outliers reported			
Sodium	1	+ve	6 - XRF	Not reported
Sulphur	1	+ve	6 - XRF	Not reported
Titanium	2	-ve	6 - XRF	12:22 flux to form a glass bead

Note: Z-scores could not be determined for Loss on Ignition due to the small number of results returned.

6. References

- [1] *Guide to Proficiency Testing Australia*, 2016. (This document can be found on the PTA website, www.pta.asn.au)
- [2] SA TR 2.35:2014 *Certified reference materials - Iron ore - Preparation and certification of ASCRM-035 (Yilgarn Hematite)*

APPENDIX A

Results and Data Analysis

Aluminium	A1.1
Arsenic	A2.1
Calcium	A3.1
Copper	A4.1
Iron	A5.1
Magnesium	A6.1
Manganese	A7.1
Phosphorous	A8.1
Potassium	A9.1
Silicon	A10.1
Sodium	A11.1
Sulphur	A12.1
Titanium	A13.1
Loss on Ignition	A14.1

Aluminium (Al) (%)

Lab Code	Result 1 (%)	Result 2 (%)	Average (%)	Absolute Difference	MU	Detection Limit	Method Code	Dissolution/Digestion Technique	Robust z-score
1	0.79	0.79	0.790	0.00	#	0.01	6	NA	7.00 §
2	0.71	0.71	0.710	0.00	#	#	6	12:22 flux to form a glass bead	-1.00
3	0.729	0.720	0.725	0.009	0.03	0.01	6	Fused Bead	0.45
4	0.715	0.711	0.713	0.004	0.007	0.053	6	Fusion using Borate Flux	-0.70

Notes:

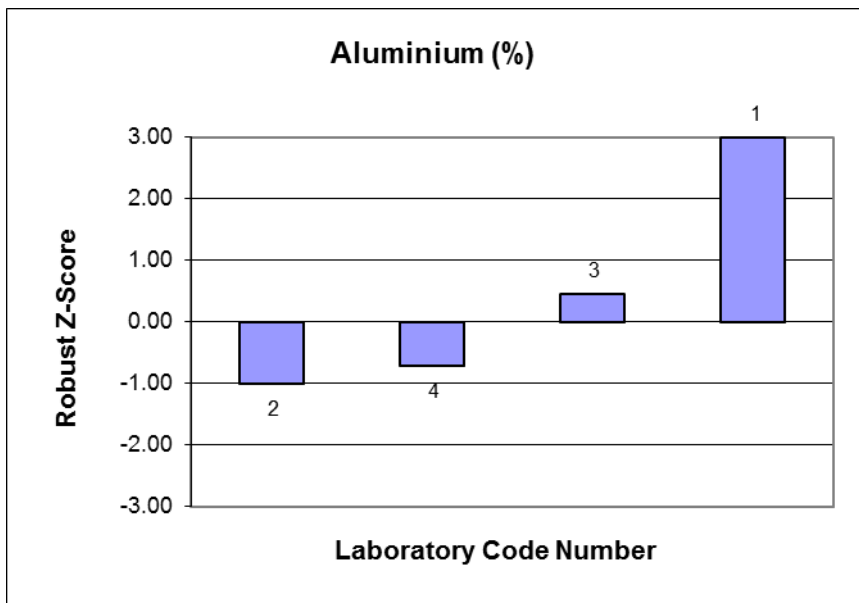
§ denotes an outlier, i.e. $|z\text{-score}| \geq 3.0$.

indicates no result returned.

Summary Statistics

No. results	4
Assigned Value	0.7200
Standard Deviation	0.01
CV	1.4%
Min	0.710
Max	0.790
Range	0.080
Uncertainty (Assigned Value)	0.0010

Aluminium (Al) (%) Ordered Z-Score Chart



Arsenic (As) (%)

Lab Code	Result 1 (%)	Result 2 (%)	Average (%)	Absolute Difference	MU	Detection Limit	Method Code	Dissolution/Digestion Technique	Robust z-score
2	0.008	0.007	0.008	0.001	#	#	6	12:22 flux to form a glass bead	-0.14

Notes:

indicates no result returned.

Summary Statistics

No. results	1
Assigned Value	0.0079
Standard Deviation	0.0029
CV	36.7%
Uncertainty (Assigned Value)	0.0005

As there was only one robust z-score result reported, no graphs are shown for this element.

Calcium (Ca) (%)

Lab Code	Result 1 (%)	Result 2 (%)	Average (%)	Absolute Difference	MU	Detection Limit	Method Code	Dissolution/Digestion Technique	Robust z-score
1	0.13	0.11	0.120	0.013	#	0.01	6	NA	0.75
2	0.12	0.13	0.125	0.001	#	#	6	12:22 flux to form a glass bead	2.00
3	0.121	0.122	0.122	0.000	0.01	0.01	6	Fused Bead	1.13
4	0.131	0.130	0.131	0.018	0.005	0.007	6	Fusion using Borate Flux	3.38 §

Notes:

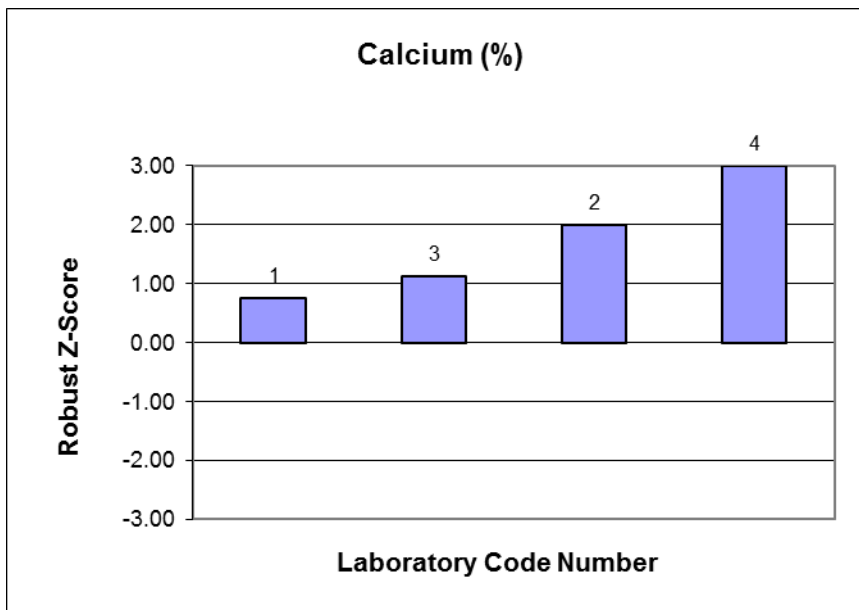
§ denotes an outlier, i.e. |z-score| ≥ 3.0.

indicates no result returned.

Summary Statistics

No. results	4
Assigned Value	0.117
Standard Deviation	0.004
CV	3.4%
Min	0.120
Max	0.131
Range	0.011
Uncertainty (Assigned Value)	0.0004

Calcium (Ca) (%) Ordered Z-Score Chart



Copper (Cu) (%)

Lab Code	Result 1 (%)	Result 2 (%)	Average (%)	Absolute Difference	MU	Detection Limit	Method Code	Dissolution/Digestion Technique	Robust z-score
2	0.008	0.009	0.009	0.001	#	#	6	12:22 flux to form a glass bead	-0.17

Note:

indicates no result returned.

Summary Statistics

No. results	1
Assigned Value	0.0087
Standard Deviation	0.0012
CV	13.8%
Uncertainty (Assigned Value)	0.0002

As there was only one robust z-score result reported, no graphs are shown for this element.

Iron (Fe) (%)

Lab Code	Result 1 (%)	Result 2 (%)	Average (%)	Absolute Difference	MU	Detection Limit	Method Code	Dissolution/Digestion Technique	Robust z-score
1	64.35	64.35	64.35	0.00	#	0.01	6	NA	5.13 §
2	62.14	62.19	62.17	0.05	#	#	6	12:22 flux to form a glass bead	-0.47
3	62.23	62.20	62.22	0.03	0.32	0.01	6	Fused Bead	-0.35
4	63.63	63.68	63.66	0.05	0.008	0.07	6	Fusion using Borate Flux	3.35 §

Notes:

§ denotes an outlier, i.e. $|z\text{-score}| \geq 3.0$.

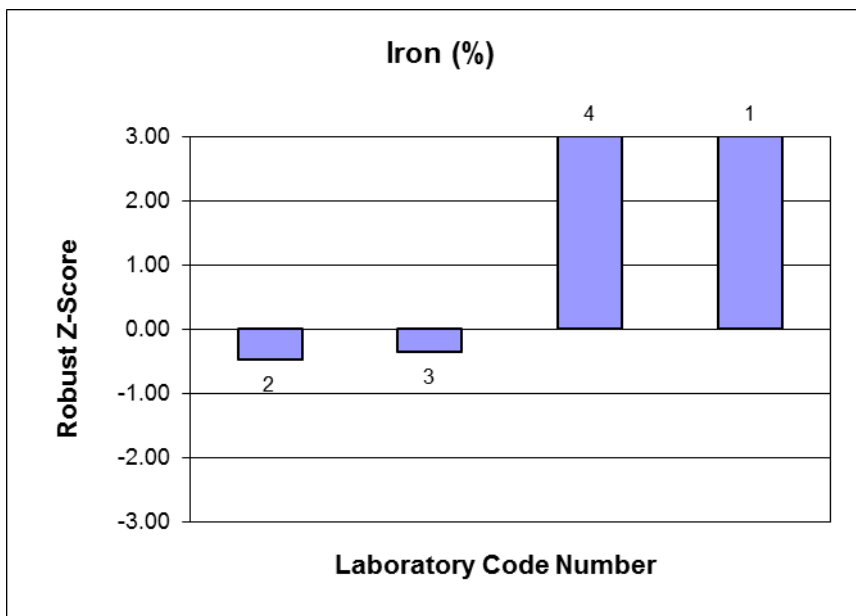
indicates no result returned.

Summary Statistics

No. results	4
Median	62.350
Norm IQR	0.390
Target CV	0.6%
Min	62.17
Max	64.35
Range	2.19
Uncertainty (Median)	0.1126

A target CV of 0.6% was used to determine z-scores for Iron.

Iron (Fe) (%) Ordered Z-Score Chart



Magnesium (Mg) (%)

Lab Code	Result 1 (%)	Result 2 (%)	Average (%)	Absolute Difference	MU	Detection Limit	Method Code	Dissolution/Digestion Technique	Robust z-score
1	0.19	0.19	0.190	0.00	#	0.01	6	NA	3.64 §
2	0.16	0.14	0.150	0.02	#	#	6	12:22 flux to form a glass bead	0.00
3	0.154	0.157	0.156	0.003	0.02	0.01	6	Fused bead	0.50
4	0.159	0.156	0.158	0.003	0.007	0.006	6	Fusion using Borate Flux	0.68

Notes:

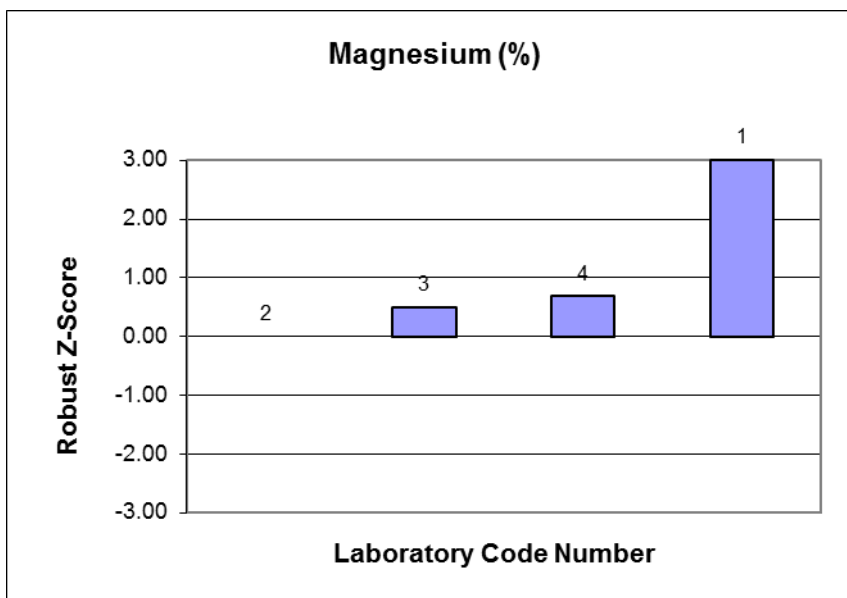
§ denotes an outlier, i.e. $|z\text{-score}| \geq 3.0$.

indicates no result returned.

Summary Statistics

No. results	4
Assigned Value	0.150
Standard Deviation	0.011
CV	7.3%
Min	0.150
Max	0.190
Range	0.040
Uncertainty (Assigned Value)	0.0011

Magnesium (Mg) (%) Ordered Z-Score Chart



Manganese (Mn) (%)

Lab Code	Result 1 (%)	Result 2 (%)	Average (%)	Absolute Difference	MU	Detection Limit	Method Code	Dissolution/Digestion Technique	Robust z-score
1	0.15	0.15	0.150	0.00	#	0.01	6	NA	-0.67
2	0.15	0.15	0.150	0.00	#	#	6	12:22 flux to form a glass bead	-0.67
3	0.149	0.147	0.148	0.002	0.01	0.002	6	Fused Bead	-1.33
4	0.163	0.163	0.163	0.000	0.005	0.008	6	Fusion using Borate Flux	3.67 §

Notes:

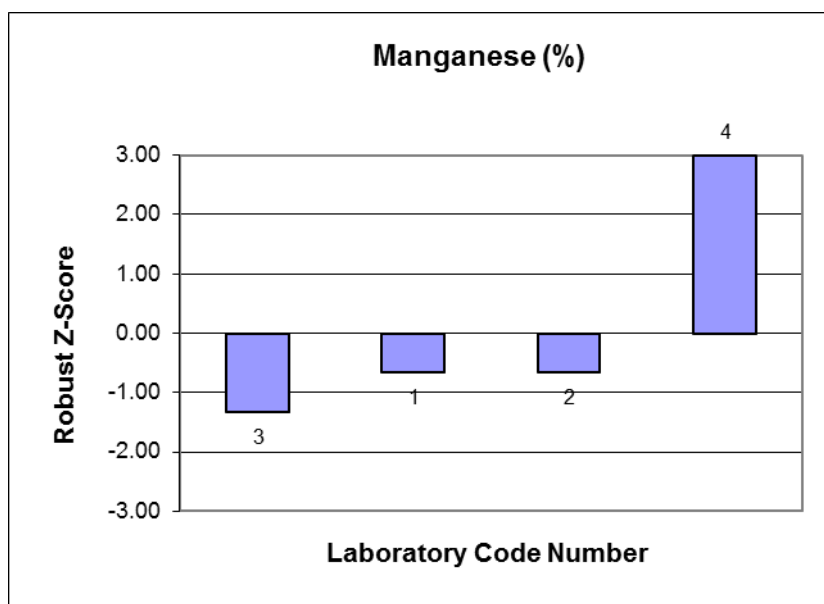
§ denotes an outlier, i.e. $|z\text{-score}| \geq 3.0$.

indicates no result returned.

Summary Statistics

No. results	4
Assigned Value	0.152
Standard Deviation	0.003
CV	2.0%
Min	0.1480
Max	0.1630
Range	0.0150
Uncertainty (Assigned Value)	0.0003

Manganese (Mn) (%) Ordered Z-Score Chart



Phosphorous (P) (%)

Lab Code	Result 1 (%)	Result 2 (%)	Average (%)	Absolute Difference	MU	Detection Limit	Method Code	Dissolution/Digestion Technique	Robust z-score
1	0.08	0.08	0.080	0.00	#	0.01	6	NA	1.00
2	0.082	0.082	0.082	0.000	#	#	6	12:22 flux to form a glass bead	2.00
3	0.074	0.076	0.075	0.002	0.01	0.001	6	Fused Bead	-1.50
4	0.078	0.079	0.079	0.001	0.001	0.004	6	Fusion using Borate Flux	0.25

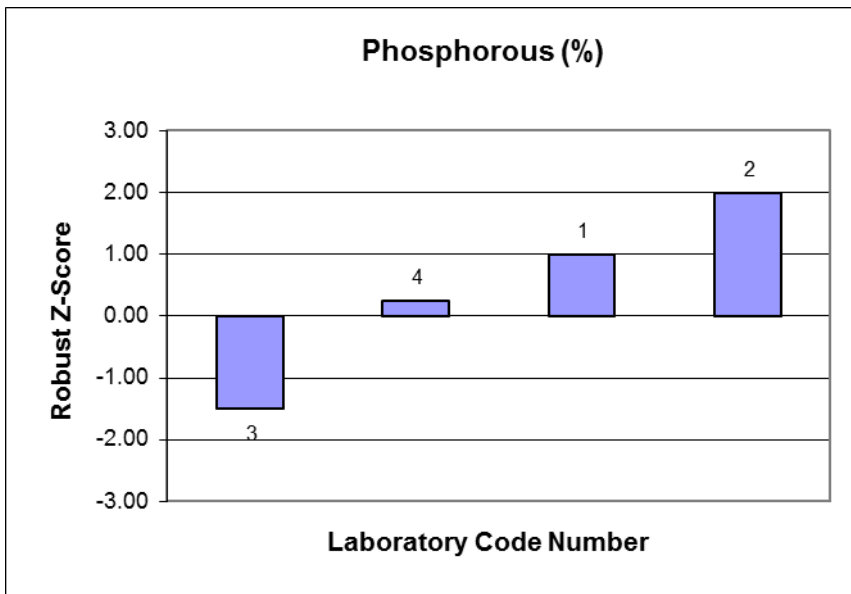
Notes:

indicates no result returned.

Summary Statistics

No. results	4
Assigned Value	0.078
Standard Deviation	0.002
CV	2.6%
Min	0.075
Max	0.082
Range	0.007
Uncertainty (Assigned Value)	0.0002

Phosphorous (P) (%) Ordered Z-Score Chart



Potassium (K) (%)

Lab Code	Result 1 (%)	Result 2 (%)	Average (%)	Absolute Difference	MU	Detection Limit	Method Code	Dissolution/Digestion Technique	Robust z-score
1	0.03	0.03	0.030	0.00	#	0.01	6	NA	3.54 §
2	0.02	0.02	0.020	0.00	#	#	6	12:22 flux to form a glass bead	-0.88
3	0.024	0.023	0.024	0.001	0.01	0.002	6	Fused Bead	0.66
4	0.022	0.022	0.022	0.000	0.003	0.008	6	Fusion using Borate Flux	0.00

Notes:

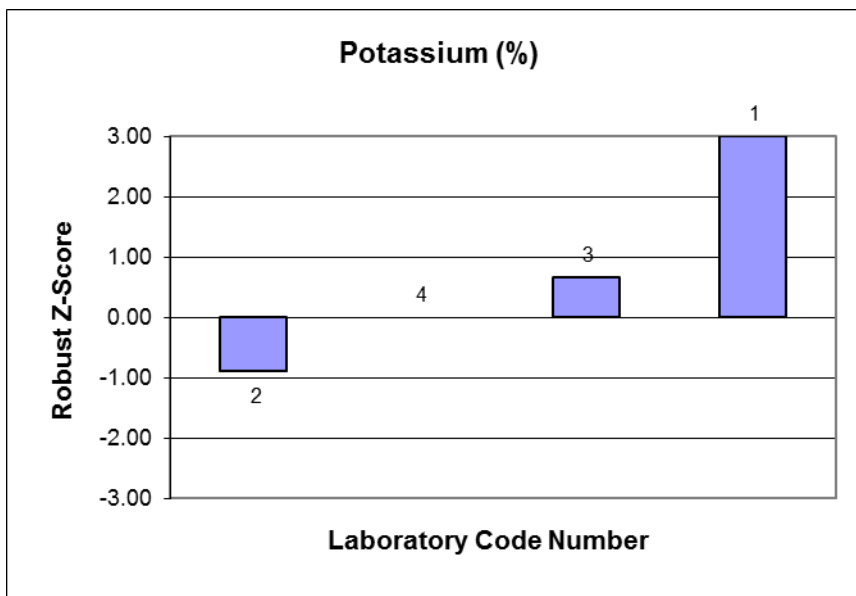
§ denotes an outlier, i.e. $|z\text{-score}| \geq 3.0$.

indicates no result returned.

Summary Statistics

No. results	4
Assigned Value	0.022
Standard Deviation	0.0023
CV	10.3%
Min	0.020
Max	0.030
Range	0.010
Uncertainty (Assigned Value)	0.0003

Potassium (K) (%) Ordered Z-Score Chart



A10.1

Silicon (Si) (%)

Lab Code	Result 1 (%)	Result 2 (%)	Average (%)	Absolute Difference	MU	Detection Limit	Method Code	Dissolution/Digestion Technique	Robust z-score
1	2.00	1.99	2.00	0.01	#	0.01	6	NA	0.25
2	2.01	1.99	2.00	0.02	#	#	6	12:22 flux to form a glass bead	0.50
3	2.04	2.01	2.03	0.03	0.04	0.01	6	Fused Bead	1.75
4	1.98	1.98	1.98	0.00	0.007	0.05	6	Fusion using Borate Flux	-0.50

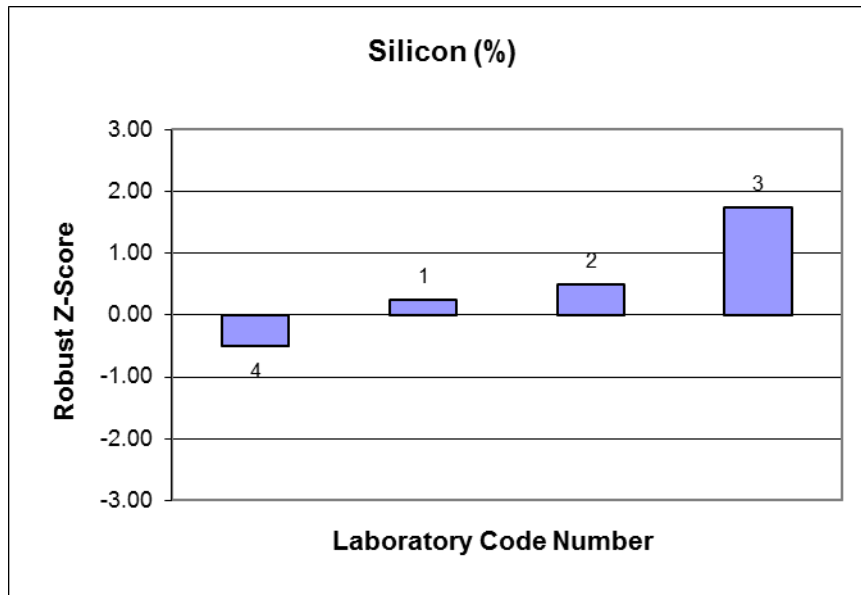
Notes:

indicates no result returned.

Summary Statistics

No. results	4
Assigned Value	1.99
Standard Deviation	0.02
CV	1.0%
Min	1.98
Max	2.03
Range	0.04
Uncertainty (Assigned Value)	0.002

Silicon (Si) (%) Ordered Z-Score Charts



Sodium (Na) (%)

Lab Code	Result 1 (%)	Result 2 (%)	Average (%)	Absolute Difference	MU	Detection Limit	Method Code	Dissolution/Digestion Technique	Robust z-score
1	0.21	0.22	0.215	0.01	#	0.01	6	NA	8.52 §
2	0.07	0.07	0.070	0.00	#	#	6	12:22 flux to form a glass bead	0.73
3	0.082	0.086	0.084	0.004	0.02	0.01	6	Fused Bead	1.48
4	0.063	0.057	0.060	0.006	0.012	0.007	6	Fusion using Borate Flux	0.19

Notes:

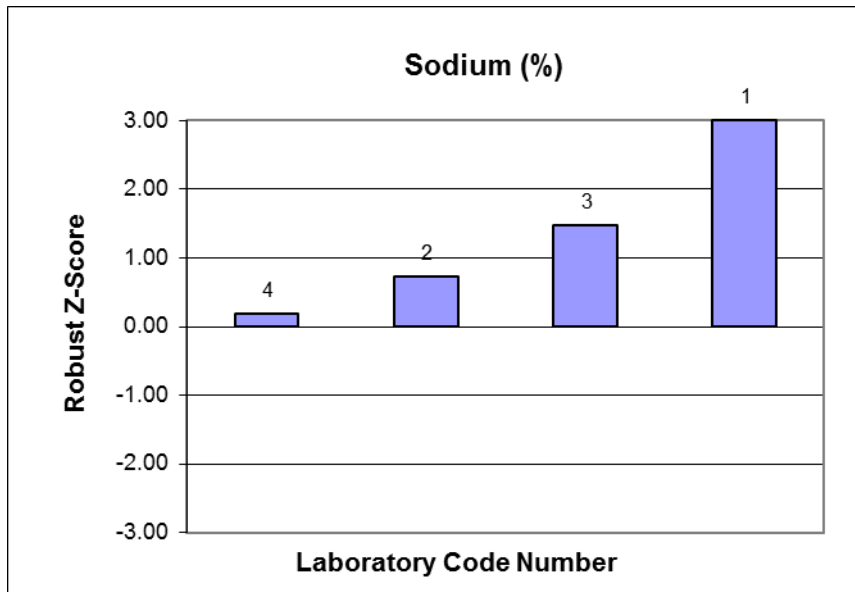
§ denotes an outlier, i.e. $|z\text{-score}| \geq 3.0$.

indicates no result returned.

Summary Statistics

No. results	4
Assigned Value	0.0565
Standard Deviation	0.0186
CV	32.9%
Min	0.060
Max	0.215
Range	0.155
Uncertainty (Assigned Value)	0.0024

Sodium (Na) (%) Ordered Z-Score Charts



Sulphur (S) (%)

Lab Code	Result 1 (%)	Result 2 (%)	Average (%)	Absolute Difference	MU	Detection Limit	Method Code	Dissolution/Digestion Technique	Robust z-score
1	0.07	0.07	0.070	0.00	#	0.01	6	NA	4.33 §
2	0.056	0.057	0.057	0.001	#	#	6	12:22 flux to form a glass bead	-0.17
3	0.050	0.053	0.052	0.003	0.01	0.001	6	Fused Bead	-1.83
4	0.062	0.062	0.062	0.000	0.005	0.004	6	Fusion using Borate Flux	1.67

Notes:

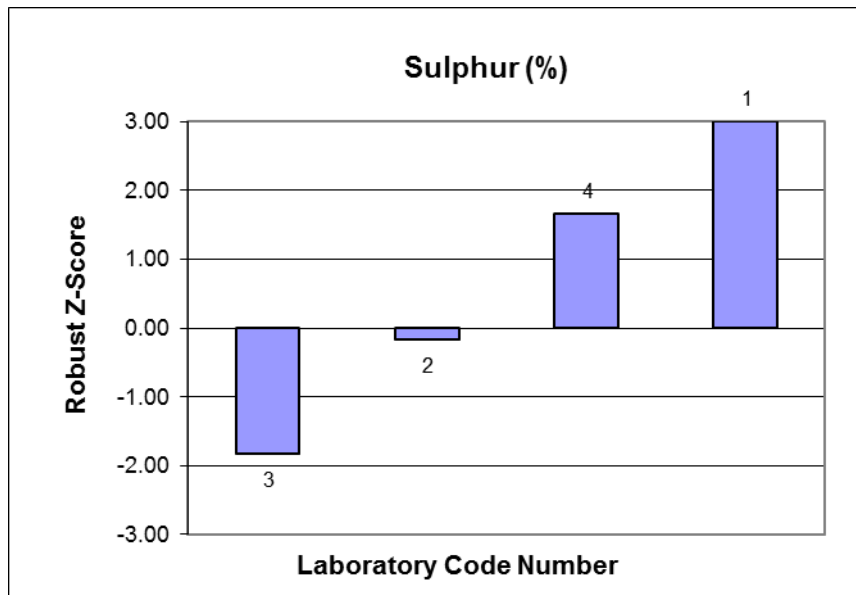
§ denotes an outlier, i.e. $|z\text{-score}| \geq 3.0$.

indicates no result returned.

Summary Statistics

No. results	4
Assigned Value	0.057
Standard Deviation	0.003
CV	5.3%
Min	0.052
Max	0.070
Range	0.019
Uncertainty (Assigned Value)	0.0003

Sulphur (S) (%) Ordered Z-Score Charts



Titanium (Ti) (%)

Lab Code	Result 1 (ppm)	Result 2 (ppm)	Average (ppm)	Absolute Difference	MU	Detection Limit	Method Code	Dissolution/Digestion Technique	Robust z-score
1	0.05	0.05	0.050	0.00	#	0.01	6	NA	2.00
2	0.04	0.04	0.040	0.00	#	#	6	12:22 flux to form a glass bead	-3.00 §
3	0.047	0.045	0.046	0.002	0.01	0.01	6	Fused Bead	0.00
4	0.047	0.049	0.048	0.002	0.003	0.006	6	Fusion using Borate Flux	1.00

Notes:

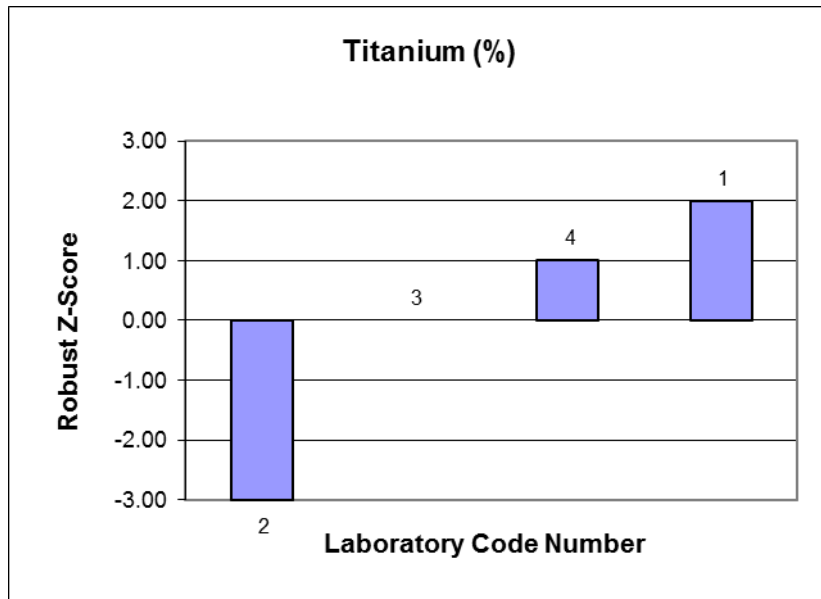
§ denotes an outlier, i.e. $|z\text{-score}| \geq 3.0$.

indicates no result returned.

Summary Statistics

No. results	4
Assigned Value	0.0460
Standard Deviation	0.0020
CV	4.3%
Min	0.040
Max	0.050
Range	0.010
Uncertainty (Assigned Value)	0.0002

Titanium (Ti) (%) Ordered Z-Score Charts



Loss on Ignition (LOI) (%)

Lab Code	Result 1 (%)	Result 2 (%)	Average (%)	Absolute Difference	MU	Detection Limit	Method Code	Dissolution/Digestion Technique
1	4.52	4.63	4.58	0.11	NA	NA	NA	NA
2	4.17	4.26	4.22	0.09	#	#	#	TGA
3	4.18	4.16	4.17	0.02	0.02	0.01	10	Leco TGA 701
4	4.49	4.49	4.49	0.00	0.01	0.005	11	#

Statistical analysis has not been performed as only a small number of numerical results (4) were returned.

Notes:

indicates no result returned.

APPENDIX B

Homogeneity Testing and Stability

Homogeneity Testing and Stability

Samples used for this round were Standards Australia certified reference material ASCRM-035 Iron Ore (Yilgarn Hematite). The nature of these samples is such that they are considered to have long-term stability under normal storage conditions, therefore, stability testing was considered unnecessary. Three random samples were selected to check homogeneity, the analysis was performed by Bureau Veritas Minerals Pty Ltd (SA).

Iron (%)		Silicon (%)		Aluminium (%)		Calcium (%)		Magnesium (%)	
Result 1	Result 2	Result 1	Result 2	Result 1	Result 2	Result 1	Result 2	Result 1	Result 2
62.21	62.13	1.97	1.98	0.73	0.73	0.11	0.11	0.16	0.16
62.15	62.19	1.98	1.97	0.73	0.71	0.11	0.12	0.16	0.16
62.18	62.25	1.99	1.99	0.73	0.73	0.11	0.11	0.16	0.16

Manganese (%)		Phosphorus (%)		Potassium (%)		Sodium (%)		Titanium (%)	
Result 1	Result 2	Result 1	Result 2	Result 1	Result 2	Result 1	Result 2	Result 1	Result 2
0.14	0.14	0.077	0.079	0.02	0.02	0.07	0.06	0.05	0.05
0.14	0.14	0.079	0.077	0.02	0.02	0.07	0.06	0.05	0.05
0.14	0.14	0.079	0.078	0.02	0.02	0.07	0.07	0.05	0.05

From the analysis of these results, it was concluded that the samples were sufficiently homogeneous.

APPENDIX C

Documentation

Instructions to Participants

C1

Results Sheet

C4

PROFICIENCY TESTING AUSTRALIA

Proficiency Testing Program Geochemical Testing – Round 14

INSTRUCTIONS TO PARTICIPANTS

Please read instructions carefully **BEFORE** commencing testing.

To ensure that the results of this program can be analysed properly, participants are asked to carefully note the following:

1. Samples

- One **Iron Ore** sample with approximately 10g in a foil sachet has been provided for each laboratory.

Samples have been thoroughly blended but please make sure your sample is thoroughly mixed before analysis and in between duplicates

2. Testing

- The testing should commence as soon as possible after receipt of the sample.
- Samples to be analysed for the below elements on a dry basis.

Aluminium	Al	Magnesium	Mg	Sodium	Na
Arsenic	As	Manganese	Mn	Sulphur	S
Calcium	Ca	Phosphorous	P	Titanium	Ti
Copper	Cu	Potassium	K	Loss on Ignition	LOI
Iron	Fe	Silicon	Si		

- Please Note: Where possible, proficiency testing samples should be treated as a routine laboratory sample.

3. Safety

- The samples are for laboratory use only.
- All required safety procedures should be followed.

4. Reporting

- Please submit results on the Results Sheet provided.
- Duplicate results are requested.
- Please specify the dissolution/digestion technique used and record the method of analysis using the attached codes (refer to page 3). Details should be provided of any method techniques that are used that are not specified in the table on page 3.
- Results should be quoted in elemental form as in listed in 2 (on previous page) and on the results sheet.
- Please report each element to the units (%) indicated on the Results Sheet along with your laboratory's detection limit for that analysis.
- Laboratories are requested to calculate and report an estimate of uncertainty of measurement for each reported measurement result.
- All estimates of uncertainty of measurement must be given as a 95% confidence interval (coverage factor $k \approx 2$). Please note that MU will not be used to evaluate participant performance in this program.
- The following significant figures are recommended for reporting:
XX.XX%, X.XX%, 0.XXX%, 0.00XX%.

5. Please return results no later than **FRIDAY 4 JANUARY 2019** to:

Kathy Weller

fax: +61 7 3217 1844

email: Kathy.Weller@pta.asn.au

6. For this program your laboratory has been allocated the code number shown on the results sheet. All reference to your laboratory in reports associated with this program will be by this code number, thus ensuring confidentiality of results.

Analysis Method Codes to be used for the Results Sheets

Method Technique	Method Code
Inductively coupled plasma atomic emission spectrometry	1
Inductively coupled plasma mass spectrometry	2
Atomic absorption spectrometry	
Flame	3
Graphite furnace	4
Hydride generation	5
X-ray fluorescence spectrometry	6
Classical wet chemical analysis	7
Colorimetric	8
Neutron activation analysis	9
Leco combustion analysis	10
Other – please specify	11

Please use a Method Code for each element tested.

PROFICIENCY TESTING AUSTRALIA
Geochemical – Round 14 - Proficiency Testing Program
Results Sheet

 Lab Code:

Analysis	Result 1	Result 2	Units	Detection Limit	Dissolution/ Digestion Technique (Please Specify)	Method Code	±MU*
Aluminium, Al			%				
Arsenic, As			%				
Calcium Ca			%				
Copper, Cu			%				
Iron, Fe			%				
Magnesium, Mg			%				
Manganese, Mn			%				
Phosphorous, P			%				
Potassium, K			%				
Silicon, Si			%				
Sodium, Na			%				
Sulphur, S			%				
Titanium, Ti			%				
Loss on Ignition (LOI)			%				

MU* Laboratories' Uncertainty of Measurement. Please report in the same units as the results for each element.

Return no later than **FRIDAY 4 JANUARY 2019**, to:

Kathy Weller, Proficiency Testing Australia.

phone: +61 7 3721 7373, fax: +61 7 3217 1844, email: Kathy.Weller@pta.asn.au

- End of Report -