Reference Material Certificate:
Crushed (<3mm) Gold Hosted Silicate Rock Chips
IMS-391

Table 1: IMS-391 Certified Values

Analyte	unit	Certified Value (y)	Standard Deviation (s)		95% Confidence Interval (CI)		u_{CRM}^	k#	U_{CRM}~	No. of Labs (ISO/IEC 17025)	No. Samples
			1 SD	1 SD Within Lab	lower	upper					
Sample Preparation and Pb Fire Assay (500g)											
Au	g/t	0.24	0.015	0.009	0.23	0.25	0.014	2.00	0.027	14	68
As-received X-ray Photon Assay (500g)											
Au	g/t	0.24	0.022	0.018	0.23	0.24	0.024	2.00	0.048	17	85

Table 2: IMS-391 Informational Values

Analyte	unit	Value (y)	Standard Deviation (s)		95% Confidence Interval (CI)		u_{CRM}^	k#	U_{CRM}~	No. of Labs	No. Samples
			1 SD	1 SD Within Lab	lower	upper					
As-received PAL (500g)											
Au	g/t	0.15	0.016	0.006	0.14	0.17	0.013	2.36	0.031	7	34

Note 1. SI units equivalent: 1 ppm, parts per million ≡ grams per ton ≡ mg/kg ≡ ug/g ≡ 0.0001 wt.% ≡ 1000ppb, parts per billion
Note 2. The number of decimal places quoted does not imply accuracy of the certified value to this level but are given to minimise rounding errors when calculating 2SD and 3SD.
^ Standard uncertainty.
# Coverage Factor.
~ Expanded Uncertainty.

Material and Method of Preparation

IMS-391 is a patented product manufactured from an engineered rock, with dispersed gold embedded within the mineralogical structure. This crushed reference material was further prepared by multi-stage homogenisation and sub-sampling in rotary sample dividers. The final product was packed at nominal 500g or 2kg masses, in labelled heat-sealed bags for individual use in their entirety. The packaged sample must not be sub-sampled prior to sample preparation for fire assay, or if directly assayed via photon assay.

During the packaging stage samples were drawn for homogeneity and characterisation studies. The samples taken were randomised before being submitted for material characterisation to independent ISO/IEC 17025 accredited laboratories for homogeneity and inter-laboratory round-robin testing.

Multi-element results provide valuable analytical information to assist laboratories in selecting the optimal procedure when performing a digest and analysis of the reference material. A single sample was analysed by lithium-borate fusion with x-ray fluorescence spectrometry (XRF) determination. The multi-elemental analysis results presented in Table are informational values only.

Table 3: IMS-391 Informational Values

Analyte	XRF Value (wt.%)
Al_2O_3	15.44
BaO	0.05
CaO	8.76
Cr_2O_3	0.03
Fe_2O_3	12.66
K_2O	0.39
MgO	4.94

Analyte	XRF Value (wt.%)
MnO	0.17
Na_2O	3.18
P_2O_5	0.237
SO_3	0.16
SiO_2	51.65
TiO_2	1.94
LOI-1000°C	0.32

Homogeneity Analysis

A homogeneity study was undertaken in accordance with ISO Guide 35:2017 and ISO17034:2016 using systematically selected samples to be representative of the entire batch. The sample identifiers were randomised to ensure different production order and laboratory analytical order. These samples were submitted to a single laboratory for each method and multiple analysis in a single batch under repeatable conditions. A separate homogeneity study was conducted for each method. The homogeneity studies results were reviewed, and the material was deemed suitable for progressing to the inter-laboratory round-robin stage. A summary of the study results is presented in Table .

Table 4: IMS-391 Homogeneity Study Results

Analytical Method	X-ray Photon Assay
Number of Samples Submitted	20
Number of Samples tested	20
Total Samples in Analysis	20
No. Determinations per sample	2
Number of technically invalid	0
Mean concentration (Au g/t)	0.24
Standard Deviation (Au g/t)	0.014
Relative Standard Deviation	6%

Material Characterisation and Certification Methodology

For Pb collection Fire Assay, a total of 85 x 0.5kg samples were selected for inter-laboratory round-robin analysis, 85 samples were provided to 17 laboratories. Laboratories prepared samples by splitting, if required, followed by pulverisation and subsampling. Samples were analysed via lead collection fire-assay digestion followed by either AAS or ICP. 16 laboratories returned results in this round.

For Photon Assay, a total of 85 x 500g samples were selected for inter-laboratory round-robin analysis, 85 samples were provided to 17 X-ray Photon Assay instruments. No further sample preparation was performed.

The process of characterisation was undertaken in accordance with ISO Guide 35:2017 and ISO17034:2016 following examination of grouped laboratory results for potential technical failures by way of comparison with the established CRM submitted for analyses with the candidate material. Where required, further investigation of outliers was conducted. Laboratory results deemed technical outliers were removed from the analysis pool prior to the determination of statistical parameters. The certifying officer, in some cases, may use their judgment in identifying or eliminating outliers outside of these statistical parameters.

- Certified value was determined by average of lab averages for analytes with no outlier laboratory results, or median of median for those with outlier laboratory results
- Standard deviation (s) is the measure of spread of analyte determinations and includes inter-laboratory bias, method uncertainty, and material homogeneity uncertainty. Approximately 95% of determinations using the same analytical method are expected to be between two standard deviations either side of the certified value. The standard deviation is calculated from the validated laboratory group data less outlier laboratory and individual determinations.
- Confidence Interval (*CI*) is an estimate of the true (unknowable) analyte concentration in the material at the 95% confidence interval. For example, a 95% *CI* could be interpreted as there is a 0.95 probability that the true value is between certified value ± *CI*. The narrower the interval, the more precise the certified value. The 95% *CI* should not be used for determination of quality control gates.
- Standard Uncertainty (u_{CRM}) is the sum of variance from characterisation and homogeneity studies. The uncertainty of characterisation is derived from the standard deviation of average of laboratory averages divided by the square root of the number of laboratories. Uncertainty of material homogeneity (u_{hom}) is the sum of ANOVA within and between sample uncertainty derived from the homogeneity study in accordance with ISO Guide 35. An allowance for stability has been included in accordance with ISO Guide 35.
- Coverage Factor (k) is the students t-distribution value for two tailed test at 95%.
- Expanded Uncertainty (U_{CRM}) is the product of coverage factor and standard uncertainty, and represents the 95% confidence interval of the true unknowable analyte concentration of the batch combined with the bias from individual samples.

Commutability

This reference material is not commutable to any other analytical methods than as stated by its intended use.

Metrological Traceability

Metrological traceability of the assigned values and their uncertainties has been established through an unbroken chain to the SI unit kilogram. This is achieved through the use of accredited ISO17025 assay laboratories during homogeneity, characterisation and stability studies.

Participating laboratories

Samples were sent to the participating laboratories listed in Table a, 5b and 5c, along with sample mass and analysis method. The laboratories are presented in alphabetical order, and are not related to the laboratory number identified in Appendix 1.

Table 5a: Participating Laboratories. Pb Fire Assay

Laboratory Name	Location	Assay Mass (g)	Analysis method
ALS Global	Malaga, Western Australia	50	Au-AA26 50g fire assay, AA finish
Asanko Accra	Accra, Ghana		FA 309
Bureau Veritas Minerals	Canning Vale, Western Australia	40	(I-9105-FA-40)
Bureau Veritas Minerals	Wingfield, South Australia	40	FA002 Lead Collection Fire Assay – ICP-AES
Intertek	Bohle, Queensland	50	FA50/OE04 50g Fire Assay ICP
Intertek Genalysis	Maddington, Western Australia	25	FA25/OE 25g Lead collection fire assay
Intertek Ouagadougou	Burkina Faso	50	FA50/AAS Au-Pb collection finished with AAS
Intertek Tarkwa	Samahu Tarkwa, Ghana	50	FA50/AA
Jinning	Maddington, Western Australia	50	FA50I 50g Fire Assay ICP
MSA Bulyanhulu Gold Mine	Mwanza, Tanzania	30	FAS-211 30g fire assay, AAS finish
MSA Egypt	Egypt	30	FAS-211 30g fire assay, AA finish
MSA Mauritania Nouakchott	Mauritania	50	FAS-221 50g fire assay, AA finish
MSA Mauritania Tasiast Mine	Mauritania	50	FAS-221 50g fire assay, AA finish
MSA Shanta	Tanzania	30	FAS-211 30g fire assay, AAS finish
SGS Geochemistry	Perth Airport, Western Australia	50	GO_FAA50V10 50g fire assay AAS
SGS Gogama	Gogama, ON, Canada	30	GOFAA30V10, 30g FAS

Table 5b: Participating Laboratories. Photon Assay

Laboratory Name	Location	Assay Mass (g)	Analysis method
ALS Canning Vale	Canning Vale, Western Australia	420 - 500	Au-PA01
ALS Kalgoorlie West	Kalgoorlie, Western Australia	420 - 500	Au-PA01
Chrysos Golden Square (OSLS)	Golden Square, Victoria	420 - 500	Au-PA01
Intertek Maddington	Maddington, Western Australia	420 - 500	/PAAU02
Intertek Tarkwa	Samahu Tarkwa, Ghana	420 - 500	/PAAU02
MSA Bamako	Bamako, Mali	420 - 500	CPA-Au1
MSA Bulyanhulu Gold Mine	Mwanza, Tanzania	420 - 500	CPA-Au1
MSA Tanzania	Geita, Tanzania	420 - 500	CPA-Au1
MSA Val-d'or	Val-d'Or QC, CANADA	420 - 500	CPA-Au1

Table 5c: Participating Laboratories. PAL

Laboratory Name	Location	Assay Mass (g)	Analysis method
Asanko Accra	Accra, Ghana	420 - 500	PAL-AAS
Bureau Veritas	Norseman, Western Australia	420 - 500	PAL-AAS
CRS Björkdalsgruvan	Sweden	420 - 500	PAL-AAS
CRS Kempele	Finland	420 - 500	PAL-AAS
Intertek Calidus	Calidus Site Lab, Western Australia	420 - 500	PAL-AAS
Intertek Ouagadougou	Burkina Faso	420 - 500	PAL-AAS
MSA Mauritania Tasiast Mine Lab	Mauritania	420 - 500	PAL-AAS
Newmont Paramaribo	Paramaribo, Suriname	420 - 500	PAL-AAS
OroyaLabs Georgetown	Georgetown, Queensland	420 - 500	PAL-AAS
Rosebel Suriname	Paramaribo, Suriname	420 - 500	PAL-AAS
Superior Gold Plutonic	Western Australia	420 - 500	PAL-AAS

Preparer and Supplier of Certified Reference Material

This certified reference material, IMS-391, was prepared and certified by:

Independent Mineral Standards Pty Ltd
16 Durham Rd
Bayswater, WA 6053
Australia
Ph: +61 8 6155 7616
www.imstandards.com.au

Intended Use

The crushed reference material is intended for monitoring and testing the accuracy and precision of sample preparation and sub-sampling procedures, followed by Pb collection fire-assay or Photon assay of gold ores. These crushed reference materials are typically used in conjunction with pulverised reference materials which monitor the analysis stage only.

The estimate of material and measurement uncertainties reported in this certificate are the product of the participating laboratories, not any individual laboratory. Commercial laboratories typically have different measurement uncertainties to site-based laboratories. Application of the grouped uncertainties reported in this certificate to a specific laboratory for ongoing QC may lead to many false reports of out-of-control processes, or alternatively non reporting of out-of-control processes.

It is recommended that the centre line and control limits of a Shewhart chart used for ongoing monitoring of a particular laboratory are derived from averaged values and variation from replicate analysis of this CRM after removal of outliers.

Instructions for Correct Use

The certified values are based on the concentration level in the packaged state, and no further drying is required before weighing and analysis.

Minimum Sample Mass

The samples have been packed in nominal 500g or 2kg sealed plastic bags, and uncertainty and homogeneity statements relating to these are only applicable if the whole sample is submitted for sample preparation and subsequent analysis.

Period of Validity

This Certificate is valid 5 years from the date of original issue.

Stability and Storage Instructions

This reference material should be stored in a dry location out of direct sunlight to prevent degradation of the packaging and possible contamination of the materials. No other special storage conditions are required.

Legal Notice

Independent Mineral Standards Pty Ltd has prepared and statistically evaluated the property values of this reference material to the best of its ability. The purchaser by receipt hereof releases and indemnifies Independent Mineral Standards Pty Ltd from and against all liability and costs from the use of this material and information.

Certifying Officer

Bruce Armstrong, Operations Manager

Certification Date

30th May 2024

References

ISO Guide 35:2017, Reference materials – General and statistical principles for certification.

ISO17034:2016, General Requirements for the competence of reference material producers.

Version History

Batch #	Document Version	Date	Modification
IMS-391	R0	30/5/2024	Initial Document

Appendix 1

Tabulated and graphical presentation of certification data. (Fire Assay)

Determination No.	Laboratory Number																Overall
	G	H	K	L	N	O	V	X	Y	AA	AG	AH	AI	AJ	AK	AL	
1	0.23	0.25	0.25	0.22	0.24	0.26	0.23	0.30*	0.23	0.30*	0.25	0.25	0.25	0.24	0.24	0.23	
2	-*	0.25	0.26	0.22	0.25	0.25	0.23	0.31*	0.22	0.28*	0.21	0.26	0.25	0.23	0.25	0.22	
3	0.24	0.25	0.27	0.23	0.25	0.26	0.24	0.32*	0.23	0.29*	0.26	0.25	0.24	0.24	0.24	0.23	
4	0.23	0.25	0.28	0.23	0.24	0.27	0.22	0.30*	0.23	0.29*	0.25	0.27	0.25	0.25	0.24	0.22	
5	0.23	0.25	0.28	0.23	-*	0.25	0.23	0.31*	0.22	0.28*	0.25	0.26	0.25	0.25	0.23	0.22	
Count	4	5	5	5	4	5	5	0	5	0	5	5	5	5	5	5	68
Min	0.23	0.25	0.25	0.22	0.24	0.25	0.22	-	0.22	-	0.21	0.25	0.24	0.23	0.23	0.22	0.21
Max	0.24	0.25	0.28	0.23	0.25	0.27	0.24	-	0.23	-	0.26	0.27	0.25	0.25	0.25	0.23	0.28
Median	0.23	0.25	0.27	0.23	0.24	0.26	0.23	-	0.23	-	0.25	0.26	0.25	0.24	0.24	0.22	0.24
Mean	0.23	0.25	0.27	0.23	0.24	0.26	0.23	-	0.23	-	0.24	0.26	0.25	0.24	0.24	0.22	0.24
Std Dev	0.005	0	0.013	0.005	0.006	0.007	0.007	-	0.005	-	0.019	0.008	0.004	0.008	0.009	0.005	0.015
Coeff. Variation	2.15	0	4.69	2.14	2.36	2.77	3.07	-	2.42	-	7.99	3.24	1.8	3.46	3.68	2.17	6.34
Dev. From Cert Mean	-4.07	3.15	11.04	-5.76	1.09	5.96	-5.1	-	-6.75	-	0.68	6.45	2.33	-0.15	-0.64	-8.23	
95% Confidence Interval	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.007
SD Within Labs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.009
SD Between Labs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.030
M-Score	0.79	0.11	1.06	0.83	0.11	0.43	0.79	2.81	0.79	1.91	0.11	0.56	0.11	0.34	0.29	1.1	4
Z-Score	1.71	0.07	2.01	2.13	0.44	0.76	1.96	5.97	2.37	3.93	0.54	0.88	0.13	0.74	0.87	2.74	3

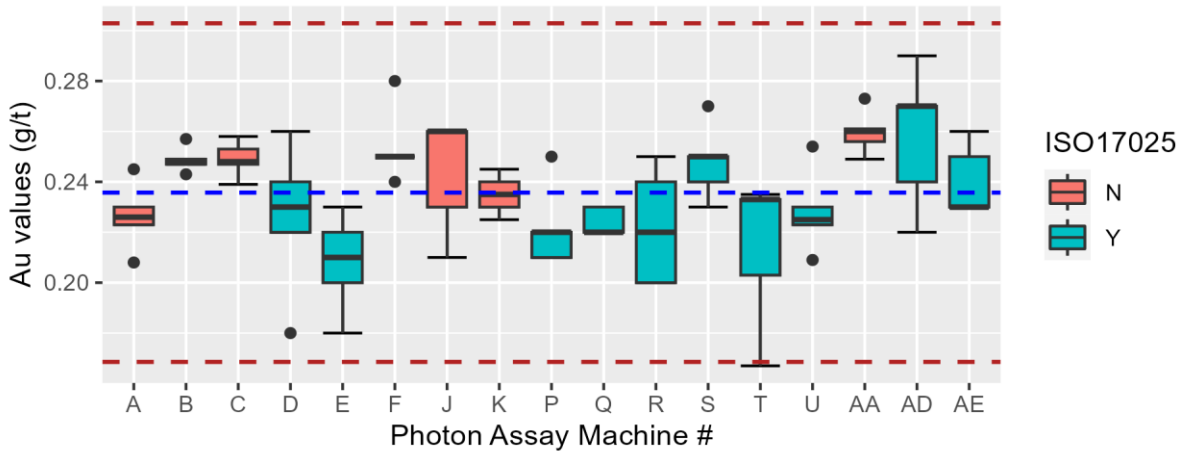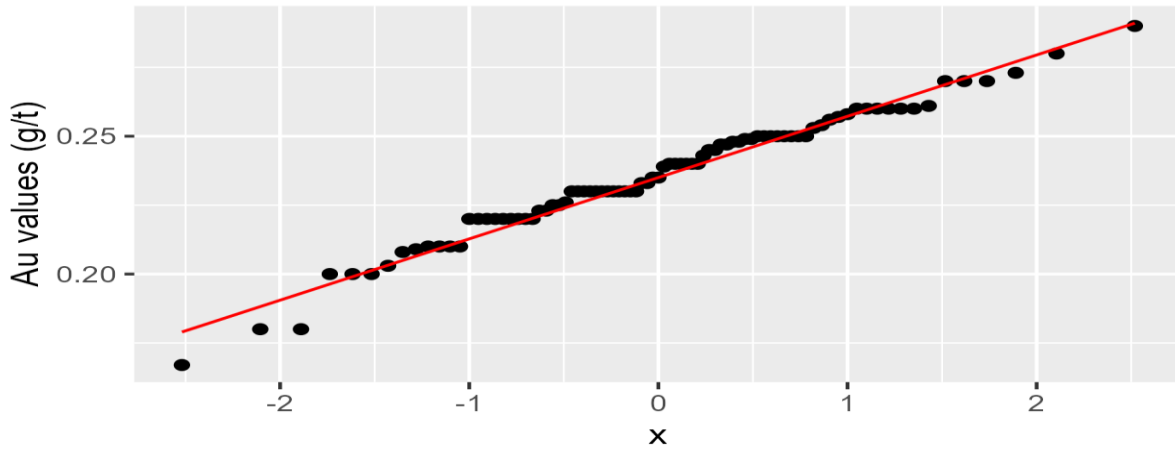## Comparative Analysis: A Boxplot Overview
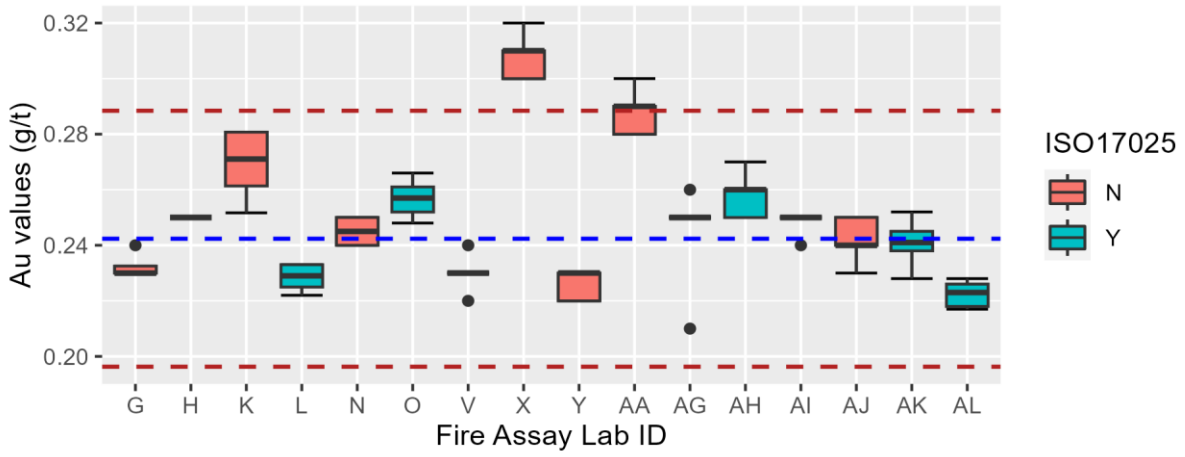
Q-Q Plot
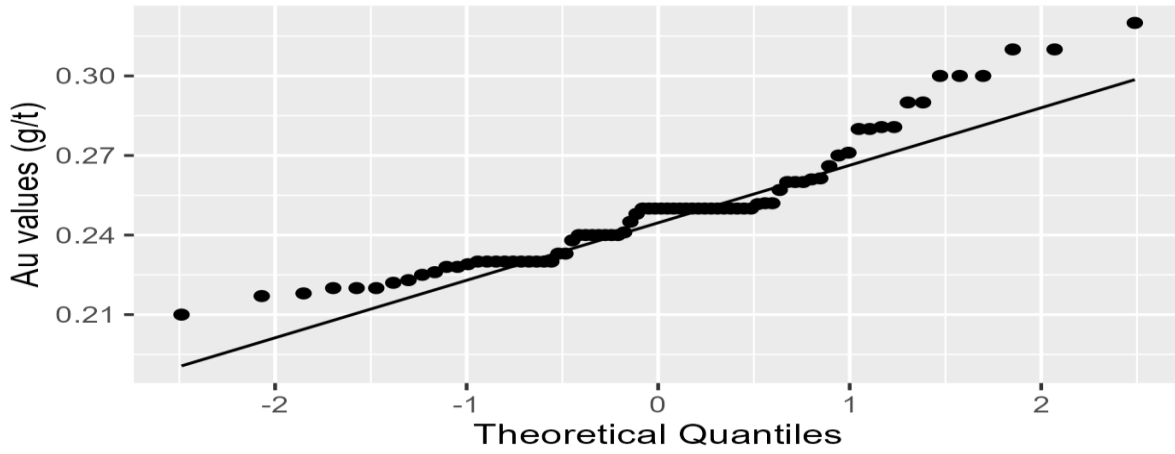
Appendix 1

Tabulated and graphical presentation of certification data. (Photon Assay)

| Determination No.	Laboratory Number																	Overall
	A	B	C	D	E	F	J	K	P	Q	R	S	T	U	AA	AD	AE	
1	0.230	0.249	0.248	0.26	0.23	0.25	0.23	0.240	0.22	0.22	0.22	0.23	0.235	0.225	0.249	0.29	0.23	
2	0.223	0.257	0.239	0.23	0.22	0.24	0.21	0.230	0.21	0.23	0.20	0.27	0.203	0.223	0.273	0.27	0.23	
3	0.208	0.247	0.247	0.22	0.18	0.28	0.26	0.225	0.21	0.23	0.24	0.24	0.233	0.254	0.261	0.22	0.23	
4	0.245	0.248	0.258	0.18	0.20	0.25	0.26	0.245	0.22	0.22	0.20	0.25	0.233	0.230	0.256	0.27	0.26	
5	0.226	0.243	0.253	0.24	0.21	0.25	0.26	0.235	0.25	0.22	0.25	0.25	0.167	0.209	0.260	0.24	0.25	
Count	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	85
Min	0.21	0.24	0.24	0.18	0.18	0.24	0.21	0.22	0.21	0.22	0.2	0.23	0.17	0.21	0.25	0.22	0.23	0.17
Max	0.24	0.26	0.26	0.26	0.23	0.28	0.26	0.24	0.25	0.23	0.25	0.27	0.23	0.25	0.27	0.29	0.26	0.29
Median	0.23	0.25	0.25	0.23	0.21	0.25	0.26	0.23	0.22	0.22	0.22	0.25	0.23	0.22	0.26	0.27	0.23	0.23
Mean	0.23	0.25	0.25	0.23	0.21	0.25	0.24	0.23	0.22	0.22	0.22	0.25	0.21	0.23	0.26	0.26	0.24	0.24
Std Dev	0.013	0.005	0.007	0.030	0.019	0.015	0.023	0.008	0.016	0.005	0.023	0.015	0.030	0.016	0.009	0.028	0.014	0.022
Coeff. Variation	5.88	2.06	2.85	13.13	9.25	5.97	9.44	3.36	7.4	2.45	10.27	5.98	13.8	7.18	3.37	10.76	5.89	9.50
Dev. From Cert Mean	-3.96	5.54	5.63	-4.13	-11.76	7.75	3.51	-0.31	-5.82	-4.98	-5.82	5.21	-9.13	-3.19	10.21	9.45	1.81	
95% Confidence Interval	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.008
SD Within Labs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.018
SD Between Labs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.035
M-Score	0.36	0.78	0.78	0.16	1.19	0.88	1.4	0.1	0.67	0.67	0.67	0.88	0	0.42	1.4	1.92	0.16	4
Z-Score	0.98	1.38	1.4	1.02	2.92	1.92	0.87	0.08	1.44	1.23	1.44	1.29	2.27	0.79	2.53	2.34	0.45	3

Comparative Analysis: A Boxplot Overview

Au Q-Q Plot

Appendix 1

Tabulated and graphical presentation of certification data. (PAL)

Determination No.	Laboratory Number										
	I	M	W	X	Y	Z	AB	AC	AF	AI	Overall
1	0.15	0.16	0.14	0.21*	0.17	0.21*	0.17	0.15	0.12*	0.14	
2	0.15	0.16	0.14	0.21*	0.16	0.25*	0.17	0.15	0.11*	0.13	
3	0.16	0.16	0.15	0.21*	0.18	0.24*	0.17	0.15	0.10*	0.12	
4	0.16	0.17	0.14	0.21*	0.18	0.17*	0.17	0.15	0.12*	0.13	
5	0.16	-*	0.13	0.22*	0.17	0.26*	0.18	0.15	0.10*	0.13	
Count	5	4	5	0	5	0	5	5	0	5	34
Min	0.15	0.16	0.13	-	0.16	-	0.17	0.15	-	0.12	0.12
Max	0.16	0.17	0.15	-	0.18	-	0.18	0.15	-	0.14	0.18
Median	0.16	0.16	0.14	-	0.17	-	0.17	0.15	-	0.13	0.16
Mean	0.16	0.16	0.14	-	0.17	-	0.17	0.15	-	0.13	0.15
Std Dev	0.005	0.006	0.008	-	0.008	-	0.005	0.003	-	0.007	0.016
Coeff. Variation	3.51	3.87	5.91	-	4.86	-	2.95	2.27	-	5.44	10.43
Dev. From Cert Mean	1.37	4.83	-9.81	-	11.77	-	10.73	-3.36	-	-15.52	
95% Confidence Interval	-	-	-	-	-	-	-	-	-	-	0.011
SD Within Labs	-	-	-	-	-	-	-	-	-	-	0.006
SD Between Labs	-	-	-	-	-	-	-	-	-	-	0.035
M-Score	0.02	0.02	0.88	2.27	0.47	3.54	0.43	0.43	2.23	1.33	4
Z-Score	0.83	0.14	3.05	6.42	1.24	8.05	1.04	1.77	6.77	4.19	3

Comparative Analysis: A Boxplot Overview
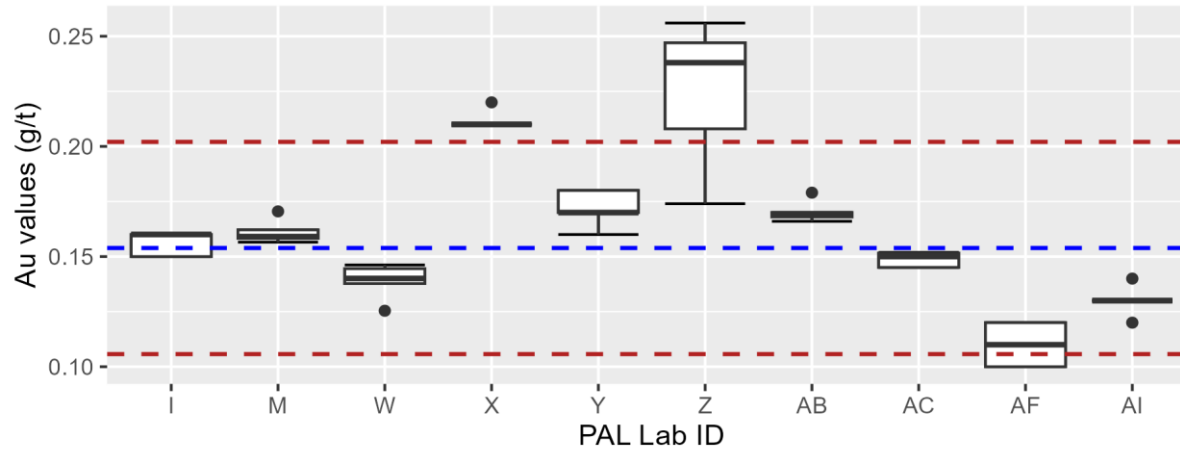
Q-Q Plot
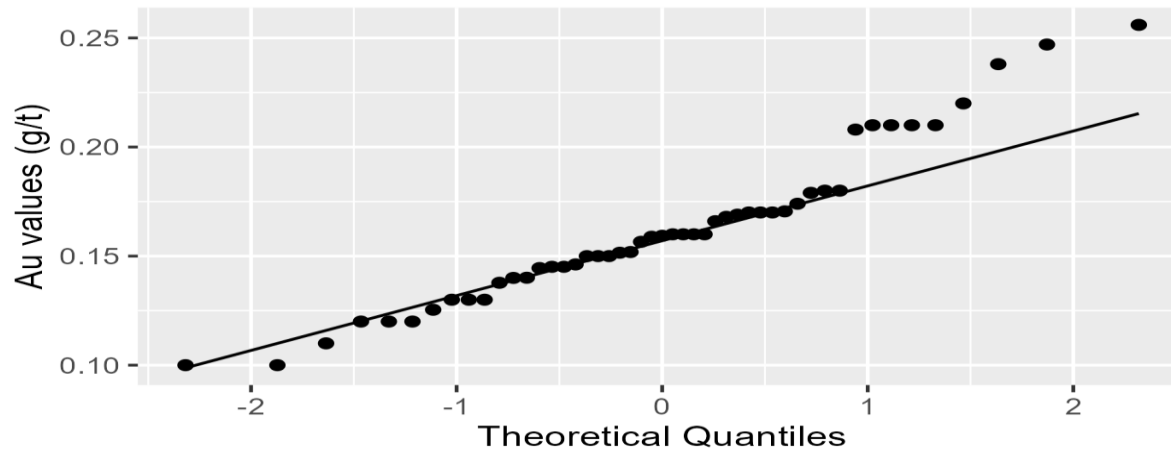
Appendix 2

Tabulated and graphical presentation of homogeneity data.

Replicate No.	14445	14446	14447	14448	14449	14450	14451	14452	14453	14454
1	0.23	0.21	0.26	0.26	0.26	0.23	0.24	0.20	0.24	0.26
2	0.23	0.22	0.24	0.23	0.21	0.24	0.26	0.25	0.21	0.22

Replicate No.	14455	14456	14457	14458	14459	14460	14461	14462	14463	14464
1	0.23	0.21	0.26	0.24	0.24	0.25	0.26	0.26	0.22	0.27
2	0.26	0.25	0.21	0.25	0.24	0.22	0.22	0.27	0.25	0.29

IMS-391 Analysis Order Box Plot Au