

## Reference Material Certificate Basalt Hosted Gold - Copper Sulphide IMS-334

Table 1a: IMS-334 Certified Values

Analyte	unit	Certified Value (y)	Standard Deviation (s)		95% Confidence Interval (CI)		uCRM <sup>^</sup>	k#	UCRM <sup>~</sup>	No. of Labs (ISO/IEC 17025)	No. Samples
			1 SD	1 SD Within Lab	lower	upper					
Fire Assay											
Au	g/t	1.45	0.034	0.023	1.43	1.46	0.024	2	0.048	13	65
Mixed Acid Digest											
Cu	ppm	6352	146	75.7	6267	6437	85	2	170	12	60

Note 1. SI units equivalent: 1 ppm, parts per million  $\equiv$  grams per ton  $\equiv$  mg/kg  $\equiv$   $\mu$ g/g  $\equiv$  0.0001 wt.%  $\equiv$  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.

<sup>^</sup> Standard uncertainty.

# Coverage Factor.

<sup>~</sup> Expanded Uncertainty.

Additional certified elements are listed in Table 1b on next page.

### Version History

Batch #	Document Version	Date	Modification
IMS-334	R0	25/06/2024	Initial Document

Table 2b: IMS-334 Certified Values

Analyte	unit	Certified Value (y)	Standard Deviation (s)		95% Confidence Interval (CI)		uCRM <sup>^</sup>	k#	UCRM <sup>~</sup>	No. of Labs (ISO/IEC 17025)	No. Samples
			1 SD	1 SD Within Lab	lower	upper					
Ag	ppm	1.9	0.33	0.17	1.7	2.2	0.36	2	0.72	10	50
Al	%	7.09	0.085	0.078	7.03	7.16	0.088	2	0.18	11	55
As	ppm	103.0	6.10	2.29	95.5	110.5	5.0	2	10	11	55
Ba	ppm	144.8	5.28	3.47	141.7	147.9	3.9	2	7.8	11	55
Be	ppm	0.8	0.17	0.06	0.6	1.0	0.51	2.45	1.2	6	30
Bi	ppm	10.0	3.75	1.60	6.9	13.1	3.5	2.31	8.2	8	40
Ca	%	5.96	0.144	0.060	5.86	6.06	0.076	2	0.15	11	55
Cd	ppm	1.6	0.38	0.23	1.2	2.0	0.42	2	0.84	10	49
Co	ppm	45.5	1.93	0.77	43.7	47.3	1.5	2	3.0	12	60
Cr	ppm	116.0	8.75	5.71	109.8	122.2	6.2	2	12	11	55
Fe	%	11.49	0.297	0.150	11.23	11.75	0.19	2	0.38	11	55
K	%	0.33	0.008	0.004	0.33	0.34	0.0052	2	0.010	11	55
La	ppm	9.5	0.53	0.03	8.5	10.5	0.63	2.45	1.5	6	30
Li	ppm	9.0	0.91	0.30	7.6	10.4	1.3	2.26	2.9	9	43
Mg	%	2.70	0.060	0.031	2.66	2.73	0.035	2	0.070	11	55
Mn	ppm	1225	41.6	16.0	1196	1253	19	2	39	11	55
Mo	ppm	3.0	0.43	0.35	3.0	3.0	1.1	2	2.1	10	49
Na	%	2.00	0.067	0.038	1.95	2.04	0.043	2	0.086	11	55
Ni	ppm	34.0	1.70	1.06	32.8	35.2	1.6	2	3.2	12	60
P	ppm	820.8	28.40	14.24	803.2	838.5	20	2	39	11	55
Pb	ppm	187.0	12.61	4.25	179.1	194.9	5.9	2	12	12	60
S	%	4.48	0.105	0.066	4.39	4.57	0.075	2	0.15	11	55
Sb	ppm	9.0	2.12	1.62	4.4	13.6	4.1	2.57	10	5	25
Sc	ppm	26.9	0.82	0.51	26.4	27.4	0.73	2	1.5	11	55
Sr	ppm	228.5	7.63	2.68	223.8	233.2	3.4	2	6.9	11	55
Ti	%	1.01	0.020	0.012	1.00	1.02	0.013	2	0.026	11	55
V	ppm	217.8	6.92	2.96	213.4	222.3	3.7	2	7.4	11	55
Zn	ppm	697.8	22.38	12.46	685.0	710.5	14	2	28	12	60
Zr	ppm	110.6	3.11	1.62	106.8	114.3	2.2	2.57	5.6	5	25

Note 1. SI units equivalent: 1 ppm, parts per million  $\equiv$  grams per ton  $\equiv$  mg/kg  $\equiv$  ug/g  $\equiv$  0.0001 wt.%  $\equiv$  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.

<sup>^</sup> Standard uncertainty.

# Coverage Factor.

<sup>~</sup> Expanded Uncertainty.

Table 3: IMS-334 Informational Values

Analyte	unit	Certified Value (y)	Standard Deviation (s)		95% Confidence Interval (CI)		uCRM^	k#	UCRM~	No. of Labs	No. Samples
			1 SD	1 SD Within Lab	lower	upper					
Mixed Acid Digest											
Ce	ppm	22.4	1.82	1.52	19.0	25.7	10	3.18	32	3	14
Ga	ppm	20.3	0.70	0.63	19.1	21.4	1.2	3.18	3.9	3	15
Nb	ppm	5.4	0.55					12.71		1	5
Sn	ppm	4.4	0.55					12.71		1	5
Te	ppm	7.8	2.58	0.58	0.0	15.8	2.8	3.18	8.9	3	11
Th	ppm	3.2	0.45					12.71		1	5
U	ppm	10.0	0.00					12.71		1	5
Y	ppm	29.0	1.66	0.21	26.8	31.3	0.97	2.57	2.5	5	25

## Material and Method of Preparation

IMS-334 is manufactured from a pulverised (95% < 105µm) basalt rock spiked with gold (Au) and blended with a copper sulphide concentrate sourced from an Australian mine site. The blended materials underwent a multi-stage homogenisation process and were discharged into storage drums. During the discharge the material was sub-sampled at regular intervals from which homogeneity and characterisation samples were drawn.

The samples taken were randomised before being submitted to independent ISO17025 accredited laboratories for homogeneity and inter-laboratory round-robin testing.

## 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 two separate laboratories for multiple analysis in a single batch under repeatable conditions.

Firstly, analysis was performed using instrument neutron activation analysis (INAA) for single element Au, with an aliquot mass (1g) significantly below common practice for gold analysis. The reduced aliquot mass method is used to test material homogeneity by amplifying the volume-variance effect of small masses, whilst using an analytical method with suitable measurement uncertainty. The reduced aliquot INAA results have been scaled to equivalent 25g variance by using the method of Ingamells and Switzer (1973).

Secondly, analysis was performed using a four-acid digest with an ICP-OES finish for multiple elements with an aliquot mass of 0.2g.

The homogeneity study results for both methods were reviewed, and the material was deemed suitable for progressing to the inter-laboratory round-robin stage. A summary of the study results for Au and Cu are presented in Appendix 2 and Table 4.

Table 4: IMS-334 Homogeneity Study Results

Analytical Method	INAA (Au, ppm)	FA equivalent (Au, ppm)	4A-OES (Cu, ppm)
Aliquot mass (g)	1	25	0.2g
Number of Samples Submitted	20	-	20
Number of Samples tested	20	-	20
Total Samples in Analysis	20	-	20
No. Determinations per sample	2	-	2
Number of technically invalid	0	-	0
Mean concentration	1.43	1.43	6321
Material Standard Deviation equivalent	0.028	0.006	57.6
Relative Standard Deviation	1.9	0.4	0.9

## Material Characterisation and Certification Methodology

A total of 65 x 100g samples were selected for inter-laboratory round-robin analysis, 5 samples were provided to 13 laboratories. Laboratories analysed samples via lead collection fire-assay digestion followed by either AAS or ICP, and also by four-acid digest with ICP finish for a standard suite of elements. All laboratories returned results in this round.

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 analysis 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 laboratory averages for analytes with no outlier laboratory results, or median of laboratory medians 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.
- Within laboratory standard deviation ( $s_w$ ) is the average spread of determination values across the reporting laboratories, less outlier laboratory and individual determinations. This is calculated by single factor ANOVA of the participating laboratory groups.
- 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  $\pm$  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, homogeneity, and stability 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.

The certified value of any elemental concentration may not be negative even though in some cases the uncertainty error bounds define a range less than 0%. These cases are due to low concentrations of some analytes relative to the analytical detection limits and increments of precision.

Analytes have been categorised as Certified or Informational based on:

- Confirmation of sufficient between-unit variance demonstrating material homogeneity.
- Sufficient agreement between all laboratories.
- A comparison of results between ISO17025 and non-ISO17025 accredited laboratories.

## Participating laboratories

The participating laboratories are listed in Table 5. The laboratories are presented in alphabetical order, and are not related to the laboratory number identified in Appendix 1.

Table 5: Participating Laboratories

Laboratory Name	Location	Analysis methods
Activation Labs	Ancaster, Canada	30g Fire Assay ICP-AAS (1A2), 4 Acid Digest ICP-OES package (1F2)
ALS	Malaga, Australia	50g Fire Assay ICP (Au-ICP22), 4-Acid Digest ICP-OES package (ME-ICP61)
ALS	North Vancouver, Canada	30g Fire Assay ICP (Au-ICP21), 4-Acid Digest ICP-OES package (ME-ICP61)
ALS	Loughrea, Ireland	50g Fire Assay ICP (Au-ICP22), 4-Acid Digest ICP-OES package (ME-ICP61)
Bureau Veritas	Canning Vale, Australia	40g Fire Assay AAS (FA001)
Bureau Veritas	Wingfield, Australia	40g Fire Assay AAS(FA001), 4-Acid Digest ICP-OES package (MA101)
Bureau Veritas	Vancouver, Canada	50g Fire Assay ICP(FA350-Au), 4-Acid Digest ICP-OES package (MA300)
Intertek	Maddington, Australia	25g Fire Assay ICP (FA25/OE04), 4 Acid Digest ICP-OES package (4A/OE33)
Intertek	Jakarta, Indonesia	30g Fire Assay AA (FA30/AA), 4 Acid Digest ICP-OES package (4A/OE33)
Intertek	Townsville, Australia	50g Fire Assay ICP (FA50/OE04), 4-Acid Digest ICP-OES package (4A/OE33)
MSA Labs	Langley, Canada	50g Fire Assay ICP (FAS124), 4-Acid Digest ICP-OES package (ICP-230)
SGS	Burnaby, Canada	50g Fire Assay ICP (GE_FAI50V5), 4-Acid Digest ICP-OES package (GE_ICP40Q12)
SGS	Perth, Australia	50g Fire Assay AAS (GE_FAA50V5), 4-Acid Digest ICP-OES package (GE_ICP40Q12)

## Preparer and Supplier of Certified Reference Material

This certified reference material, IMS-334, was prepared and certified by:

### Independent Mineral Standards Pty Ltd

16 Durham Rd  
Bayswater, WA 6053  
Australia  
Ph: +61 8 6155 7616  
[imstandards.com.au](http://imstandards.com.au)

The material is available in sealed 1 kg PET jars boxes, with unique labels showing the batch number.

## Minimum Sample Mass

This reference material has been certified for the analysis of Au by fire assay using aliquots ranging from 25g to 50g. This reference material has also been certified for Cu and other available elements using four-acid digest using 0.2g aliquots. Uncertainty and homogeneity statements relating to each applicable analysis are only applicable for the corresponding minimum aliquot sample mass.

## Intended Use

The pulverised reference material is intended for monitoring and testing the accuracy and precision of Pb collection fire-assay analysis, and multi-element ICP analysis of gold-copper ores. This intended use may include a quality control program within a minerals or mine site laboratory.

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.

## Period of Validity

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

## Commutability

This pulverised 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 for Certified Values in Table 1. This is achieved by selecting and comparing results from sufficient assay laboratories accredited to ISO17025. Where there was insufficient data to establish metrological traceability the results are listed as informational values in Table 2.

## Stability and Storage Instructions

Jars should be stored in a cool dry location, and mixed by shaking the sealed container before opening for first use. This product contains sulphide material. Once opened it is recommended to re-seal opened jars when not in use. The long-term storage of this product is monitored, and purchasers will be notified if changes are observed during the period of validity of the product.

## 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.

## 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 - ISO17034:2016 authorised signatory

## Certification Date

25 June 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.

## Appendix 1

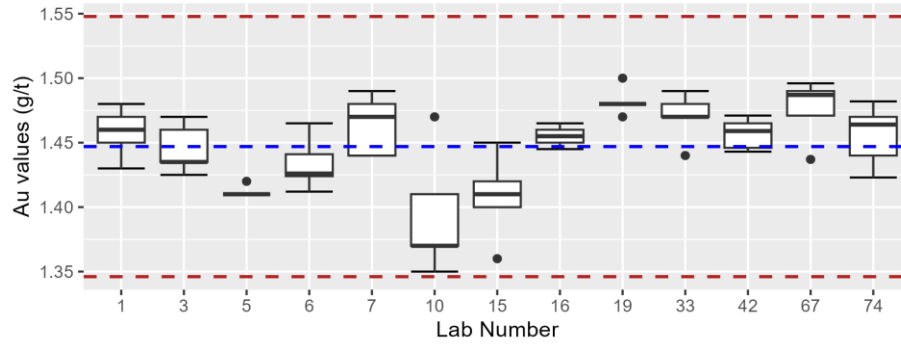
Tabulated and graphical presentation of certification data.

Au Determination (ppm)	Laboratory Number													Overall
	Lab 1	Lab 3	Lab 5	Lab 6	Lab 7	Lab 10	Lab 15	Lab 16	Lab 19	Lab 33	Lab 42	Lab 67	Lab 74	
<b>Detection Limit</b>	0.005	0.001	0.01	0.005	0.01	0.01	0.001	0.001	0.01	0.01	0.005	0.002	0.002	
<b>1</b>	1.45	1.425	1.41	1.412	1.44	1.37	1.36	1.455	1.48	1.49	1.446	1.471	1.482	
<b>2</b>	1.43	1.435	1.41	1.424	1.48	1.47	1.40	1.445	1.50	1.47	1.465	1.487	1.464	
<b>3</b>	1.48	1.460	1.42	1.465	1.44	1.35	1.45	1.460	1.48	1.47	1.443	1.437	1.440	
<b>4</b>	1.46	1.435	1.41	1.426	1.49	1.37	1.42	1.450	1.48	1.44	1.471	1.496	1.470	
<b>5</b>	1.47	1.470	1.41	1.441	1.47	1.41	1.41	1.465	1.47	1.48	1.459	1.490	1.423	
<b>Count</b>	5	5	5	5	5	5	5	5	5	5	5	5	5	65
<b>Min</b>	1.43	1.43	1.41	1.41	1.44	1.35	1.36	1.45	1.47	1.44	1.44	1.44	1.42	1.35
<b>Max</b>	1.48	1.47	1.42	1.47	1.49	1.47	1.45	1.47	1.50	1.49	1.47	1.50	1.48	1.50
<b>Median</b>	1.46	1.44	1.41	1.43	1.47	1.37	1.41	1.46	1.48	1.47	1.46	1.49	1.46	1.46
<b>Mean</b>	1.46	1.45	1.41	1.43	1.46	1.39	1.41	1.46	1.48	1.47	1.46	1.48	1.46	1.45
<b>Std Dev</b>	0.019	0.019	0.004	0.02	0.023	0.048	0.033	0.008	0.011	0.019	0.012	0.024	0.024	0.034
<b>Coeff. Variation</b>	1.32	1.32	0.32	1.42	1.57	3.43	2.32	0.54	0.74	1.27	0.83	1.61	1.64	2.32
<b>Dev. From Cert Mean</b>	0.76	-0.14	-2.42	-0.92	1.18	-3.66	-2.69	0.56	2.42	1.59	0.68	2.02	0.61	
<b>95% Confidence Interval</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	0.017
<b>SD Within Labs</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	0.023
<b>SD Between Labs</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	0.061
<b>M-Score</b>	0.03	0.77	1.57	1.06	0.35	2.86	1.57	0.13	0.67	0.35	0	0.9	0.16	4
<b>Z-Score</b>	0.17	0.03	0.55	0.21	0.27	0.84	0.61	0.13	0.55	0.36	0.16	0.46	0.14	3

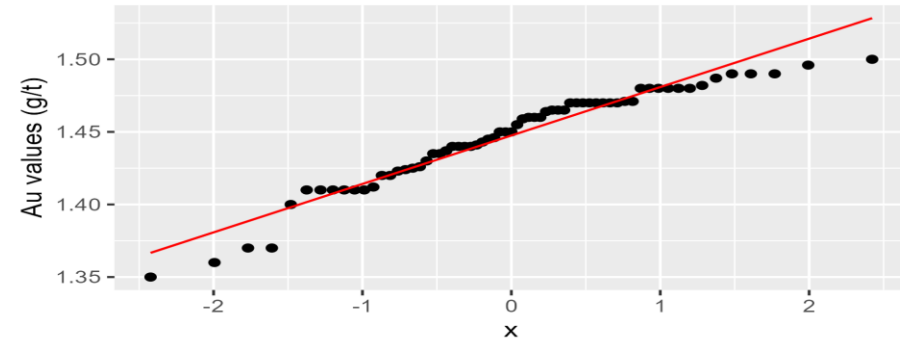


	Laboratory Number													
Cu Determination (ppm)	Lab 1	Lab 3	Lab 5	Lab 6	Lab 7	Lab 10	Lab 15	Lab 16	Lab 19	Lab 33	Lab 42	Lab 67	Lab 74	Overall
<b>Detection Limit</b>	1	1	1	1	1	5	1	1	0.5	-	1	2	1	
<b>1</b>	6240	6280	6300	6271	6220	6342	6560	6600	6270	-*	6504	6276	6470	
<b>2</b>	6300	6460	6320	6299	6290	6412	6550	6470	6297	-*	6476	6255	6476	
<b>3</b>	6200	6300	6180	6364	6140	6326	6580	6400	6342	-*	6427	6187	6377	
<b>4</b>	6270	6260	6160	6297	6230	6256	6670	6470	6293	-*	6496	6168	6477	
<b>5</b>	6040	6270	6180	6275	6240	6383	6470	6640	6330	-*	6613	6145	6698	
<b>Count</b>	5	5	5	5	5	5	5	5	5	0	5	5	5	60
<b>Min</b>	6040	6260	6160	6271	6140	6256	6470	6400	6270	-	6427	6145	6377	6040.0
<b>Max</b>	6300	6460	6320	6364	6290	6412	6670	6640	6342	-	6613	6276	6698	6698.0
<b>Median</b>	6240	6280	6180	6297	6230	6342	6560	6470	6297	-	6496	6187	6476	6297.0
<b>Mean</b>	6210	6314	6228	6301.2	6224	6343.8	6566	6516	6306.4	-	6503.2	6206.2	6499.6	6352
<b>Std Dev</b>	101.98	82.95	75.63	37.3	54.13	59.62	71.62	100.15	29.23	-	68.29	56.63	118.68	146
<b>Coeff. Variation</b>	1.64	1.31	1.21	0.59	0.87	0.94	1.09	1.54	0.46	-	1.05	0.91	1.83	2.30
<b>Dev. From Cert Mean</b>	-2.23	-0.59	-1.94	-0.79	-2.01	-0.12	3.38	2.59	-0.71	-	2.39	-2.29	2.33	
<b>95% Confidence Interval</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	80.81
<b>SD Within Labs</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	75.7
<b>SD Between Labs</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	299.0
<b>M-Score</b>	0.43	0.13	0.89	0	0.51	0.34	2	1.32	0	-	1.52	0.84	1.36	4
<b>Z-Score</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	3

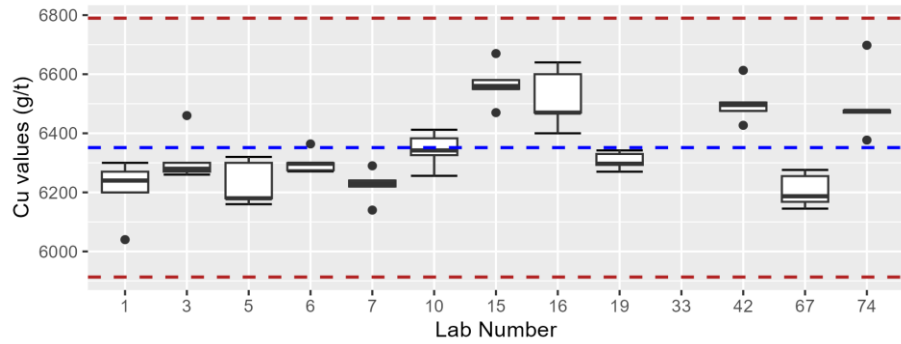
Au Box Plot



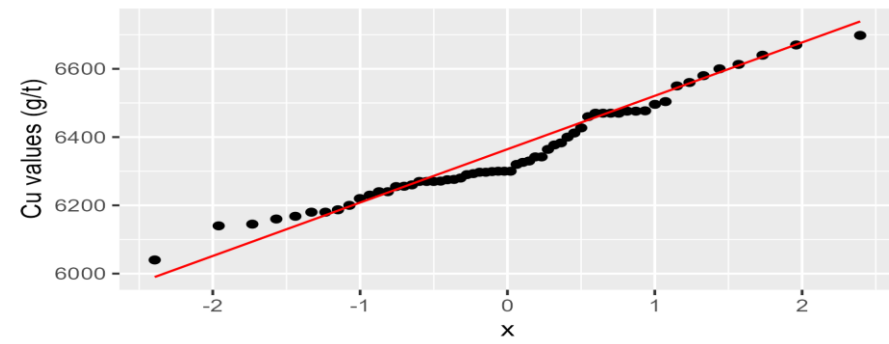
Au Q-Q Plot



Cu Box Plot



Cu Q-Q Plot

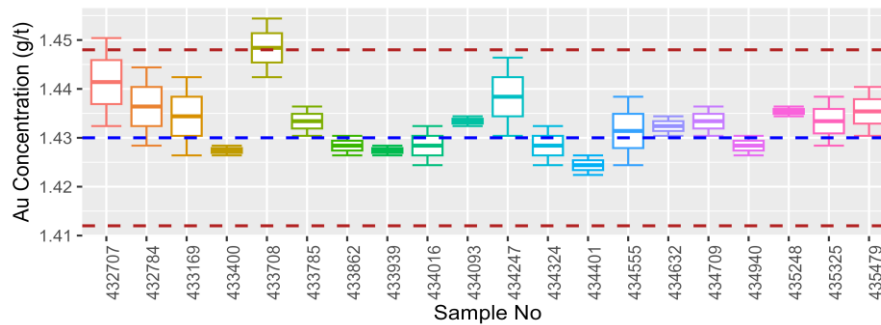


## Appendix 2

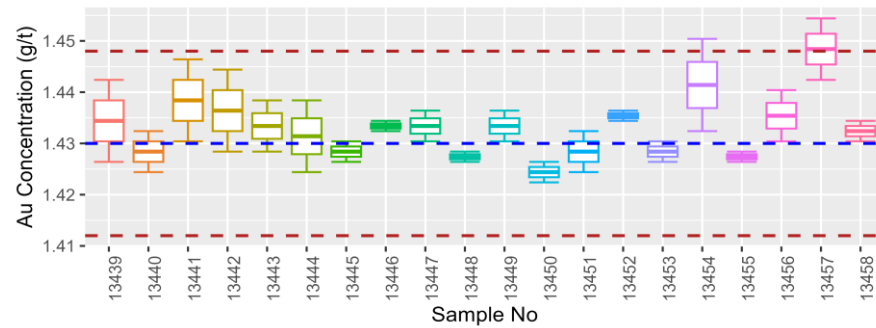
Tabulated and graphical presentation of homogeneity data.

Au	13439	13440	13441	13442	13443	13444	13445	13446	13447		
1	1.44	1.42	1.43	1.43	1.43	1.44	1.43	1.43	1.44		
2	1.43	1.43	1.45	1.44	1.44	1.42	1.43	1.43	1.43		
Au	13448	13449	13450	13451	13452	13453	13454	13455	13456	13457	13458
1	1.43	1.43	1.42	1.42	1.43	1.43	1.45	1.43	1.44	1.45	1.43
2	1.43	1.44	1.43	1.43	1.44	1.43	1.43	1.43	1.43	1.44	1.43

IMS-334 Production Order Box Plot conversion\_25g\_FireAssay



IMS-334 Analysis Order Box Plot conversion\_25g\_FireAssay

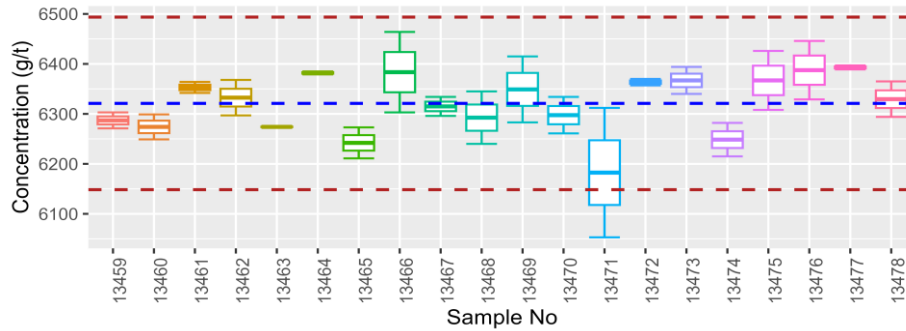


Cu	13459	13460	13461	13462	13463	13464	13465	13466	13467
1	6,271	6,299	6,364	6,297	6,275	6,379	6,273	6,464	6,296
2	6,303	6,249	6,342	6,368	6,273	6,385	6,211	6,303	6,334

	13468	13469	13470	13471	13472	13473	13474	13475	13476	13477	13478
1	6,240	6,415	6,334	6,312	6,370	6,340	6,282	6,308	6,446	6,389	6,294
2	6,345	6,283	6,261	6,053	6,357	6,394	6,215	6,426	6,329	6,397	6,365

Cu Analysis Order Box Plot



Cu Production Order Box Plot

