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Certificate of Analysis

Reference Material PK08

Recommended values and 95% Confidence Intervals
Platinum Concentration: 2.365 µg/g (± 0.038)
Palladium Concentration: 5.926 µg/g (± 0.119)
Gold Concentration: 4.956 µg/g (± 0.073)

The above values apply only to product in jars or sachets which have an identification number within the following range: ***573319–573611***

Prepared and Certified By:

Eoin Foster
Rocklabs Reference Materials
Scott Technology
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Date of Certification: 07 August 2023

Certificate Status: Original

Available Packaging: This reference material has been packed in wide-mouthed jars that contain 2.5 kg of product. The contents of some jars may be subsequently repacked into sealed polyethylene sachets.

Origin of Reference Material: Concentrates containing platinum, palladium, and gold that have been screened very finely to remove any nuggets and then blended with an appropriate matrix of barren minerals.

Supplier of Reference Material:

ROCKLABS
P O Box 18-142
Glen Innes
Auckland 1743
NEW ZEALAND
Email: rocklabs.sales@scottautomation.com
Website: www.rocklabs.com

Description:

The reference material is a light grey powder that has been well mixed. A homogeneity test was carried out after the entire batch was packaged into wide-mouthed jars. There is no soil component. The product contains crystalline quartz, so dust from it should not be inhaled.

The approximate chemical composition is**:**

(Uncertified Values)

	%
SiO_2	49.95
Al_2O_3	10.29
Na_2O	2.73
K_2O	2.56
CaO	4.92
MgO	17.50
TiO_2	1.15
MnO	0.13
P_2O_5	0.30
Fe_2O_3	8.13
L O I	2.34

Intended Use:

This reference material is designed to be included with every batch of samples analysed and the results plotted for quality monitoring and assessment purposes.

Stability:

The container (jar or sachet) should not be heated to, or stored at temperatures higher than 50 °C. Where the container remains unopened, the reference material will remain stable for more than 10 years from the date of certification. When exposed to the atmosphere the reference material is stable, with total weight changes of less than 0.5 % at naturally occurring temperature and humidity extremes.

Method of Preparation:

This reference material has been produced under quality management systems certified to ISO 9001:2015

Following ILAC Guidelines G12:2000 and G13:2000, finely screened concentrates containing platinum, palladium and gold were blended with appropriate matrix of barren minerals. Once the powders were uniformly mixed, the composite was placed into 293 wide-mouthed jars, each bearing a unique number. 24 jars were randomly selected from the packaging run and material from these jars was used for both homogeneity and consensus testing.

Homogeneity Assessment:

Sampling was performed by Rocklabs, and an independent laboratory carried out gold analysis by fire assay of 30 g portions, using an ICP-AES finish. Steps were taken to minimize laboratory method variation in order to better detect any variation in the candidate reference material.

Homogeneity: A sample was removed from the top of each of the 24 jars randomly selected from the 293 jars in the batch. The results of the analysis of the 24 samples (randomly ordered and then consecutively numbered before being sent to the laboratory) produced a relative standard deviation of 0.9% for platinum, 0.8 % for palladium, and 0.7% for gold.

Settling: The contents of 3 randomly selected jars were compacted by vibration (to simulate the effect of freighting) and 5 samples were removed from each jar successively from top to bottom. In addition, 5 samples were removed from the last jar in the series. No top to bottom gradation in the gold values was observed.

Analytical Methodology:

Once homogeneity had been established, two sub-samples were submitted to several well-recognized laboratories in order to assign platinum, palladium and gold values by consensus testing. The sub-samples were drawn from 24 randomly selected jars and each laboratory received samples from two different jars.

Each laboratory was instructed to analyse the samples for platinum, palladium and gold using the method they believed would give the best results. Indicative concentration ranges were given.

The samples were analysed for gold by all participating laboratories using fire assay followed by either gravimetric or instrument finish (AAS or ICP). Only laboratories that routinely perform platinum and palladium were requested to analyse the samples for platinum and palladium. Most laboratories used fire assay followed by an ICP determination.

The amount of sample used in the analyses varied between laboratories, for platinum and palladium (range 5-50g) and gold (range 10-50g).

Calculation of Certified Value:

The 44 participating laboratories each returned replicate gold results using one finish method for both samples. In addition to gold, 16 of the 44 laboratories returned results for platinum and palladium. Statistical analysis to identify outliers was carried out using the principles detailed in sections 7.3.2 – 7.3.4, ISO 5725-2: 1994. Assessment of each laboratory's performance was carried out on the basis of z-scores, partly based on the concept described in ISO/IEC Guide 43-1. Details of the criteria used in these examinations are available on request. As a result of these statistical analyses, four sets of results were excluded for the purpose of assigning a platinum concentration value, two sets were excluded for palladium, and six sets for gold. A recommended value was thus calculated from the average of the remaining sets of replicate results. The 95% confidence interval was estimated using the formula:

$$X \pm ts/\sqrt{n}$$

(where X is the estimated average, s is the estimated standard deviation of the laboratory averages, and t is the 0.025 tail-value from Student's t-distribution with n-1 degrees of freedom). The recommended value is provided at the beginning of the certificate in µg/g (ppm) units. A summary of the results used to calculate the recommended value for platinum and palladium is listed below and for gold is listed on page 5. Names of the laboratories that submitted results are listed on page 6. The results are listed in increasing order of the individual laboratory averages.

Statistical analysis of the consensus test results has been carried out by independent statistician, Dr Daniel Walsh.

Summary of Results Used to Calculate Platinum Value

(Listed in increasing order of individual laboratory averages)

Platinum ppm		
Sample 1	**Sample 2**	**Set average**
2.234	2.342	2.288
2.35	2.24	2.295
2.325	2.32	2.322
2.33	2.33	2.33
2.34	2.33	2.335
2.313	2.371	2.342
2.34	2.38	2.36
2.36	2.36	2.36
2.38	2.4	2.39
2.44	2.44	2.44
2.46	2.46	2.46
2.47	2.45	2.46
Average of the 12 sets		2.365 ppm
Standard deviation of the 12 sets		0.06 ppm
Relative standard deviation		2.5%
95% confidence interval for average		+/- 0.038 ppm

Summary of Results Used to Calculate Palladium Value

(Listed in increasing order of individual laboratory averages)

Paladium ppm		
Sample 1	**Sample 2**	**Set average**
5.31	5.81	5.56
5.362	5.831	5.597
5.71	5.74	5.725
5.74	5.879	5.81
6.02	5.74	5.88
5.893	5.882	5.887
5.88	5.9	5.89
5.88	5.91	5.895
5.92	6.12	6.02
6.03	6.09	6.06
6.1	6.11	6.105
6.15	6.14	6.145
6.19	6.14	6.165
6.21	6.23	6.22
Average of the 14 sets		5.926 ppm
Standard deviation of the 14 sets		0.206 ppm
Relative standard deviation		3.5%
95% confidence interval for average		+/- 0.119 ppm

Summary of Results Used to Calculate Gold Value

(Listed in increasing order of individual laboratory averages)

Gold ppm		
Sample 1	Sample 2	Set average
4.290	4.250	4.270
4.273	4.614	4.444
4.630	4.630	4.630
4.780	4.530	4.655
4.710	4.750	4.730
4.770	4.730	4.750
4.625	4.933	4.779
4.789	4.800	4.794
4.800	4.790	4.795
4.855	4.770	4.812
4.758	4.891	4.825
4.880	4.860	4.870
4.825	4.960	4.892
4.910	4.890	4.900
4.931	4.970	4.950
5.000	4.990	4.995
4.930	5.070	5.000
5.040	4.970	5.005
4.970	5.050	5.010
5.060	4.980	5.020
5.010	5.030	5.020
5.050	5.010	5.030
5.040	5.020	5.030
5.050	5.020	5.035
5.030	5.040	5.035
5.050	5.030	5.040
5.110	4.990	5.050
5.100	5.010	5.055
5.070	5.130	5.100
5.140	5.110	5.125
5.140	5.110	5.125
5.120	5.160	5.140
5.150	5.170	5.160
5.160	5.220	5.190
5.230	5.220	5.225
5.270	5.220	5.245
5.170	5.410	5.290
5.230	5.410	5.320
Average of the 38 sets		4.956 ppm
Standard deviation of the 38 sets		0.223 ppm
Relative standard deviation		4.5%
95% confidence interval for average		+/- 0.073 ppm

Note: ***Neither the Standard deviation nor the Confidence interval should be used as a basis to set control limits when plotting individual laboratory results.***
See notes under "Instructions and Recommendations for Use" (pg 6)

Participating Laboratories

Australia	ALS Minerals, Kalgoorlie
	ALS Minerals, Perth
	ALS Minerals, Townsville
	† Bureau Veritas Amdel, Adelaide
	† Intertek Genalysis Laboratory Services, Perth
Burkina Faso	ALS Minerals, Burkina Faso
Canada	Actlabs Val dÓr
	† ALS Minerals, Vancouver
	ALS Minerals, Val d'Or
	Bourlamaque Assay Laboratories, Quebec
	† Bureau Veritas Commodities Canada Ltd, Vancouver
	† MSALABS Inc., Langley BC
	† SGS Minerals Services, Lakefield, Ontario
	† SGS Minerals Services, Vancouver
	Techni-lab, Ste-Germaine-Boule
Chile	ALS Minerals, Santiago
China	† Fujian Zijin Mining and Metallurgical Testing, Xiamen
Côte d'Ivoire	Bureau Veritas Mineral Laboratories, Abidjan
	ENVAL, Yamoussoukro
Ghana	ALS Minerals, Kumasi
	Intertek Minerals, Samahu
Guyana	MSALABS, East Coast Demerara.
Ireland	† ALS Minerals, Loughrea
Kyrgyz Republic	† Stewart Assay and Environmental Laboratories LLC, Kara-
Laos	ALS Geochemistry, Vientiane
Mali	Bureau Veritas, Mali
	MSALABS, Bamako
Mexico	BV Minerals, Hermosillo
Mangolia	ALS Minerals, Ulaanbaatar
	ALS Mongolia, You Tolgoi
Morocco	† REMINEX Research Center, Casablanca
New Zealand	† SGS New Zealand Ltd, Otago
	SGS New Zealand Ltd, Waihi
Peru	† ALS Minerals, Lima
	Minera Yanacocha SRL – Newmont, Lima
Romania	ALS Minerals, Rosia Montana
South Africa	† ALS Minerals, Edenvale – Johannesburg
Tanzania	MSA Laboratories, Mwanza
Turkey	ALS Minerals, Izmir
USA	ALS Minerals, Reno
	† Bureau Veritas Commodities and Trade, Sparks
	Nevada Gold Mines,Goldstrike
	McClelland Laboratories, Sparks
Zimbabwe	† Performance Laboratories, Ruwa

Note: The symbol † identifies laboratories that analysed the samples for platinum, palladium and gold. All laboratories listed above analysed the samples for gold.

Instructions and Recommendations for Use:

Weigh out quantity usually used for analysis and analyse for total gold by normal procedure. Homogeneity testing has shown that consistent results are obtainable for gold when 30g portions are taken for analysis.

We quote a 95% confidence interval for our estimate of the declared value. This confidence interval reflects our uncertainty in estimating the true value for the gold content of the reference material. The interval is chosen such that, if the same procedure used here to estimate the declared value were used again and again, 95% of the trials would give intervals that contained the true value. It is a reflection of how precise the trial has been in estimating the declared value. It **does not** reflect the variability any particular laboratory will experience in its own repetitive testing.

Some users have used our consensus testing statistical data to establish control limits for assessing acceptance of laboratory results. Our certification process produces precise statistical data based on the proficiency program and not on an individual laboratory. Such use inevitably leads to many apparent out-of-control points, leading to doubts about the laboratory's testing, or of the reference material itself.

Our suggested best practice would be to accumulate a history of the test results obtained and plot them on a control chart to determine any laboratory bias and variability. The appropriate centre line and control limits for this chart should be based on the average level and variation exhibited in the laboratory's **own** data. This chart will provide a clear picture of the long-term stability or otherwise of the laboratory testing process, providing good clues as to the causes of any problems. To help our customers do this, we can provide a free Excel template that will produce sensible graphs, with intelligently chosen limits, from the customer's own data.

Our instructions are recommendations for the appropriate use of reference materials. If our statistical data is used for control limits due to practicality and particular circumstances, please consult with us and we will be happy to assist and advise.

Legal Notice:

This certificate and the reference material described in it have been prepared with due care and attention. However, Scott Technology Ltd and Nano Consulting Ltd accept no liability for any decisions or actions taken following the use of the reference material.

References:

For further information on the preparation and validation of this reference material please contact Eoin Foster.

Certifying Officer

Eoin Foster

Eoin Foster
Manufacturing Manager

Independent Statistician

Daniel Walsh

Dr Daniel Walsh, PhD