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Certificate of Analysis

Reference Material SL105

Recommended Values and 95% Confidence Intervals
Gold Concentration: 5.050 (+/- 0.035) µg/g
Silver Concentration: 30.4 (+/- 0.5) µg/g

The above values apply only to product in jars or sachets which have an identification number within the following ranges: ***466490 – 466766, 467045 – 467345.***

Prepared and Certified By:

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Date of Certification: 31 October 2018

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: Feldspar minerals, basalt and iron pyrites with minor quantities of finely divided gold and silver-containing minerals that have been screened to ensure there is no gold nugget effect.

Supplier of Reference Material:

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

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

The approximate chemical composition is**:**

(Uncertified Values)	
SiO_2	56.72
Al_2O_3	15.23
Na_2O	4.69
K_2O	4.31
CaO	3.19
MgO	3.13
TiO_2	0.89
MnO	0.07
P_2O_5	0.26
Fe_2O_3	4.80
Fe	2.8
S	3.2

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) and its contents 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 atmosphere iron pyrites are likely to oxidize. Tests have shown that the increase in weight of an exposed reference material of similar matrix, in the Auckland climate, is less than 0.1% per year.

Method of Preparation: Following ILAC Guidelines G12:2000 and G13:2000, pulverized feldspar minerals, basalt rock and barren iron pyrites were blended with finely pulverized and screened gold-containing minerals. Once the powders were uniformly mixed the composite was placed into 578 wide-mouthed jars, each bearing a unique number. 16 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 Reference Materials and an independent laboratory carried out gold analysis by fire assay of 30 g portions, using a gravmetric 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 16 jars randomly selected from the 578 jars in the batch. The results of analysis of the 16 samples (randomly ordered then consecutively numbered before being sent to the laboratory) produced a relative standard deviation of 0.2 % and 0.4 % for silver.

Settling: The contents of 2 randomly selected jars were compacted by vibration (to simulate the effect of freighting) and 5 samples were removed successively from top to bottom from each jar. In addition, 5 samples were removed from the last jar in the series. No top to bottom gradation in the gold values was observed neither was there a significant difference between the last jar and the other jars.

Analytical Methodology:

Once homogeneity had been established, two sub-samples were submitted to a number of well-recognized laboratories in order to assign gold and silver values by consensus testing. The sub-samples were drawn from the 16 randomly selected jars and each laboratory received samples from two different jars. Each laboratory was instructed to analyse the samples for gold and silver using the method they believed would give the best results. Indicative concentration ranges were provided.

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 silver analysis were requested to analyse the samples for silver. A range of methods were used between labs, ranging from variations on acid digest/instrument finish, to fire assay/gravimetric finish.

The amount of sample used in the analyses varied between laboratories for both gold (range 15 - 50g) and silver (range 0.1 - 2.0g digest/instrument; and 30g fire assay/gravimetric).

Calculation of Certified Value:

The 53 participating laboratories each returned replicate gold results using one finish method for both samples. In addition, 23 of the 53 laboratories returned replicate sets of silver results for the same samples. 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, 12 sets of results were excluded for the purpose of assigning a gold concentration value and 2 sets were excluded for silver. Recommended values were

thus calculated from the average of the remaining n = 41 sets of replicate results for gold and n = 21 for silver.

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 values are provided at the beginning of the certificate in µg/g (ppm) units.

A summary of the results used to calculate the recommended value for silver and gold are listed on page 4 and page 5 respectively. The 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, Tim Ball.

Summary of Results Used to Calculate Silver Value

(Listed in increasing order of individual laboratory averages)

Silver (ppm)		
Sample 1	**Sample 2**	**Set Average**
28.0	28.0	28.00
28	29	28.5
28.99	29.34	29.165
29.2	29.2	29.20
29	30	29.5
31.00	28.00	29.500
30.33	30.00	30.167
30.00	31.00	30.500
30.4	30.7	30.55
31.16	30.27	30.715
31	31	31.0
30.6	31.4	31.00
31	31	31.0
31	31	31.0
31	31	31.0
31	31	31.0
31.1	31.1	31.10
30.7	31.5	31.10
31.00	32.00	31.500
33	30	31.5
32.0	31.2	31.60

Average of 21 sets	=	30.4 ppm
Standard deviation of 21 sets	=	1.0 ppm
Relative standard deviation	=	3.4 %
95% Confidence interval for average	=	+/- 0.5 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 7)*

Summary of Results Used to Calculate Gold Value

(Listed in increasing order of individual laboratory averages)

Gold (ppm)		
Sample 1	**Sample 2**	**Set Average**
4.810	4.880	4.845
4.806	4.909	4.858
4.880	4.840	4.86
4.870	4.870	4.87
4.905	4.961	4.933
4.900	5.000	4.95
4.99	4.94	4.965
5.00	4.95	4.975
4.968	4.996	4.982
4.988	5.021	5.005
5.060	4.960	5.01
5.02	5.00	5.01
5.024	5.000	5.012
5.03	4.99	5.012
5.024	5.003	5.0135
5.012	5.019	5.0155
5.067	4.971	5.019
5.048	4.994	5.021
4.980	5.070	5.025
4.966	5.095	5.031
4.980	5.090	5.035
5.00	5.07	5.035
5.040	5.030	5.035
5.080	5.010	5.045
5.150	4.950	5.05
5.040	5.080	5.06
4.960	5.170	5.065
5.070	5.080	5.075
5.135	5.020	5.078
5.110	5.060	5.085
5.09	5.08	5.085
5.160	5.030	5.095
5.170	5.080	5.125
5.130	5.140	5.135
5.110	5.230	5.17
5.169	5.204	5.187
5.200	5.200	5.2
5.258	5.149	5.204
5.20	5.22	5.21
5.32	5.31	5.315
5.350	5.380	5.365

Average of 41 sets	=	5.050 ppm
Standard deviation of 41 sets	=	0.111 ppm
Relative standard deviation	=	2.2 %
95% Confidence interval for average:	=	+/- 0.035 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 7)

Participating Laboratories

Australia	ALS Minerals, Kalgoorlie
	ALS Minerals, Orange
	† ALS Minerals, Perth
	† ALS Minerals, Townsville
	† Bureau Veritas Amdel, Adelaide
	Bureau Veritas Amdel, Kalgoorlie
	† Intertek Genalysis Laboratory Services, Perth
	† SGS Minerals Services, Perth
	† SGS Minerals Services, Townsville
Burkina Faso	ALS Minerals, Burkina Faso
	SEMAFO Burkina Faso S.A.
Canada	ALS Minerals, Val-d'Or
	ALS Minerals, Vancouver
	Bourlamaque Assay Laboratories, Quebec
	Bureau Veritas Commodities Canada Ltd, Ontario
	† Bureau Veritas Commodities Canada Ltd, Vancouver
	† Met-Solve Analytical Service Inc., Langley BC
	† SGS Minerals Services, Lakefield, Ontario
	† SGS Minerals Services, Vancouver
	Techni-Lab S.G.B. Abitibi Inc/Actlabs, Val d'Or
	† Techni-Lab S.G.B. Abitibi Inc/Actlabs, Ste-Germaine-Boule
	TSL Laboratories Inc, Saskatoon
Côte d'Ivoire	Bureau Veritas Mineral Laboratories, Abidjan
Ghana	ALS Minerals, Kumasi
Ireland	† ALS Minerals, Loughrea
Kyrgyz Republic	† Stewart Assay and Environmental Laboratories LLC, Kara-Balta
Laos	ALS Geochemistry, Vientiane
Mexico	† Inspectorate de Mexico - Bureau Veritas Group
Mongolia	ALS Minerals, Ulaanbaatar
	† ALS Minerals. Oyu Tolgoi
New Zealand	SGS New Zealand Ltd, Otago
	† SGS New Zealand Ltd, Waihi
Peru	ALS Minerals, Lima
	† Inspectorate Services Perú S.A.C., Callao
	† Minera Yanacocha SRL – Newmont, Lima
Romania	† ALS Minerals, Rosia Montana
Russia	† Irgiredmet Analytical Centre, Irkutsk
South Africa	† ALS Minerals, Edenvale - Johannesburg
	Sibanye Stillwater Analytical Laboratory, Driefontein Operations
	Sibanye Stillwater, Beatrix Division
	Performance Laboratories, Barberton
	SGS, Randfontein
	SGS, Rustenburg
Turkey	Acme Analitik Laboratuar Hizmetleri Ltd, Sirketi
	ALS Minerals, Izmir
USA	ALS Minerals, Reno
	Barrick Goldstrike – Met Services, Nevada
	† Inspectorate, Sparks
	† McClelland Laboratories Inc., Sparks
	Newmont Mining Corporation, Carlin
	Newmont Mining Corporation, Lone Tree
	Newmont Mining Corporation, Twin Creeks
Zimbabwe	Performance Laboratories, Ruwa

Note: The symbol † identifies laboratories that analysed the samples for both gold and silver. All laboratories listed above analysed the samples for gold.

Instructions and Recommendations for Use:

Weigh out quantity usually used for analysis and analyse by normal procedure. Do not dry before weighting.

We quote a 95% confidence interval for our estimate of the declared value. This confidence interval reflects our uncertainty in estimating the true values for the gold and silver content of the reference material. The interval is chosen such that, if the same procedure as used here to estimate the declared value were used again and again, then 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 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 ROCKLABS Ltd, Scott Technology Ltd and Tim Ball 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 Franz Lim.

Certifying Officer

Franz Lim (BSc)

Independent Statistician

Tim Ball BSc (Hons)