

Certificate of Analysis

Reference Material OxL159

Recommended Gold Concentration: 5.849 µg/g

95% Confidence Interval: +/- 0.042 µg/g

The above values apply only to product in jars or sachets which have an identification number within the following range: **471561– 474928**.

Prepared and Certified By:

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Date of Certification:

12 June 2019

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:

Basalt and feldspar minerals with minor quantities of finely divided gold-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	58.53
Al ₂ O ₃	16.70
Na ₂ O	4.56
K ₂ O	5.43
CaO	3.88
MgO	3.52
TiO ₂	1.00
MnO	0.07
P ₂ O ₅	0.28
Fe ₂ O ₃	5.20
L O I	0.45

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 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:

Following ILAC Guidelines G12:2000 and G13:2000, pulverized basalt rock and feldspar minerals were blended with finely pulverized and screened gold-containing minerals. Once the powders were uniformly mixed the composite was placed into 3368 wide-mouthed jars, each bearing a unique number. 60 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 an ICP

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 60 jars randomly selected from the 3368 jars in the batch. The results of analysis of the 60 samples (randomly ordered then consecutively numbered before being sent to the laboratory) produced a relative standard deviation of 0.7 %.

Settling: The contents of 6 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 a gold value by consensus testing. The sub-samples were drawn from 60 randomly selected jars and each laboratory received samples from two different jars.

The samples were analysed for gold by all participating laboratories using fire assay followed by either gravimetric or instrument finish (AAS or ICP). Indicative concentration ranges were provided. The amount of sample used in the analyses varied between laboratories (range 10 - 50g).

Calculation of Certified Value:

The 53 participating laboratories each returned replicate gold results using one finish method for both 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, 8 sets of results were excluded for the purpose of assigning a gold concentration value to this reference material. A recommended value was thus calculated from the average of the remaining $n = 45$ 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 $\mu\text{g/g}$ (ppm) units. A summary of the results used to calculate the recommended value is listed on page 4 and the names of the laboratories that submitted results are listed on page 5. 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 Gold Value

(Listed in increasing order of individual laboratory averages)

Gold (ppm)		
Sample 1	Sample 2	Set Average
5.524	5.523	5.524
5.57	5.60	5.585
5.63	5.57	5.6
5.65	5.71	5.680
5.62	5.78	5.7
5.71	5.71	5.71
5.65	5.78	5.715
5.77	5.67	5.72
5.78	5.71	5.745
5.9	5.6	5.75
5.74	5.77	5.755
5.76	5.76	5.76
5.85	5.68	5.765
5.83	5.73	5.78
5.798	5.778	5.788
5.80	5.83	5.815
5.74	5.89	5.815
5.836	5.810	5.823
5.89	5.76	5.825
5.81	5.86	5.835
5.86	5.83	5.845
5.92	5.78	5.849
5.85	5.85	5.85
5.83	5.88	5.854
5.88	5.83	5.855
5.80	5.91	5.855
5.88	5.84	5.86
5.87	5.85	5.86
5.89	5.87	5.88
5.89	5.90	5.895
5.96	5.84	5.901
6.02	5.79	5.905
5.95	5.89	5.922
5.94	5.92	5.93
5.96	5.92	5.940
5.912	5.989	5.951
5.99	5.92	5.955
6.00	5.97	5.984
6.04	5.93	5.985
5.99	5.99	5.99
6.02	6.04	6.03
6.10	5.97	6.036
6.0	6.1	6.050
6.09	6.05	6.07
6.33	6.23	6.282
Average of 45 sets	=	5.849 ppm
Standard deviation of 45 sets	=	0.139 ppm
Relative standard deviation	=	2.4 %
95% Confidence interval for average:	=	+/- 0.042 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, 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 Burlamaque 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
Chile	Bureau Veritas Mineral Laboratories, Antofagasta
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, Oyu Tolgoi ALS Minerals, Ulaanbaatar
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, Beatrix Division Performance Laboratories, Barberton SGS, Randfontein SGS, Rustenburg
Turkey	Acme Analitik Laboratuvar 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

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 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)