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# Certificate of Analysis

## Reference Material Si81

**Recommended Gold Concentration: 1.790 µg/g**
**95% Confidence Interval: +/- 0.008 µg/g**

The above values apply only to product in jars or sachets which have an identification number within the following range: ***360 805– 365 189*.**

**Prepared and Certified By:**

Brett Coombridge, M.Phil. Chemistry
Rocklabs Reference Materials
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**NEW ZEALAND**
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**Date of Certification:** 26 November 2013

**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-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)** |
|---|---|
| $SiO_2$ | 55.93 |
| $Al_2O_3$ | 15.71 |
| $Na_2O$ | 4.41 |
| $K_2O$ | 5.25 |
| CaO | 3.19 |
| MgO | 3.22 |
| $TiO_2$ | 0.85 |
| MnO | 0.06 |
| $P_2O_5$ | 0.23 |
| $Fe_2O_3$ | 4.53 |
| Fe | 2.7 |
| S | 3.0 |

**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 4385 wide-mouthed jars, each bearing a unique number. 75 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 75 jars randomly selected from the 4385 jars in the batch. The results of analysis of the 74 samples (randomly ordered then consecutively numbered before being sent to the laboratory) produced a relative standard deviation of 1.5%. The test result for 1 sample was not returned from the laboratory.

*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 75 randomly selected jars and each laboratory received samples from two different jars.

Participating laboratories analysed the samples by fire assay followed by either gravimetric or instrument finish (AAS or ICP). Indicative concentration ranges were provided. Some laboratories analysed the samples twice using both methods. In this situation both sets of results were presented separately, and included in the statistical analysis. The amount of sample used in the analyses varied between laboratories (range 15 - 50g).

**Calculation of Certified Value:**

As some laboratories returned results for two different methods, 58 sets of gold results were returned from 54 laboratories. 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, 5 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 = 53 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 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** |
| 1.73 | 1.73 | 1.73 |
| 1.75 | 1.73 | 1.74 |
| 1.74 | 1.76 | 1.75 |
| 1.75 | 1.75 | 1.75 |
| 1.74 | 1.76 | 1.75 |
| 1.73 | 1.78 | 1.755 |
| 1.752 | 1.761 | 1.7565 |
| 1.76 | 1.76 | 1.76 |
| 1.757 | 1.767 | 1.762 |
| 1.746 | 1.781 | 1.7635 |
| 1.762 | 1.766 | 1.764 |
| 1.77 | 1.76 | 1.77 |
| 1.77 | 1.76 | 1.765 |
| 1.750 | 1.783 | 1.7665 |
| 1.760 | 1.775 | 1.7675 |
| 1.73 | 1.81 | 1.77 |
| 1.72 | 1.82 | 1.77 |
| 1.77 | 1.77 | 1.77 |
| 1.78 | 1.76 | 1.77 |
| 1.773 | 1.771 | 1.772 |
| 1.774 | 1.772 | 1.773 |
| 1.734 | 1.813 | 1.7735 |
| 1.78 | 1.77 | 1.775 |
| 1.78 | 1.78 | 1.78 |
| 1.77 | 1.80 | 1.785 |
| 1.81 | 1.77 | 1.79 |
| 1.78 | 1.81 | 1.795 |
| 1.75 | 1.84 | 1.795 |
| 1.80 | 1.79 | 1.795 |
| 1.795 | 1.795 | 1.795 |
| 1.77 | 1.82 | 1.795 |
| 1.765 | 1.825 | 1.795 |
| 1.79 | 1.81 | 1.8 |
| 1.80 | 1.80 | 1.8 |
| 1.82 | 1.78 | 1.8 |
| 1.800 | 1.800 | 1.8 |
| 1.82 | 1.78 | 1.8 |
| 1.804 | 1.796 | 1.8 |
| 1.81 | 1.80 | 1.805 |
| 1.788 | 1.825 | 1.8065 |
| 1.803 | 1.821 | 1.812 |
| 1.815 | 1.810 | 1.8125 |
| 1.82 | 1.81 | 1.815 |
| 1.839 | 1.794 | 1.8165 |
| 1.83 | 1.81 | 1.82 |
| 1.835 | 1.810 | 1.8225 |
| 1.850 | 1.805 | 1.8275 |
| 1.810 | 1.850 | 1.83 |
| 1.83 | 1.84 | 1.835 |
| 1.85 | 1.84 | 1.845 |
| 1.85 | 1.84 | 1.845 |
| 1.878 | 1.844 | 1.861 |
| 1.850 | 1.875 | 1.8625 |

| | | |
|---|---|---|
| Average of 53 sets | = | 1.790 ppm |
| Standard deviation of 53 sets | = | 0.030 ppm |
| Relative standard deviation | = | 1.7 % |
| 95% Confidence interval for average: | = | +/- 0.008 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, Burnie<br>ALS Minerals, Kalgoorlie<br>ALS Minerals, Orange<br>ALS Minerals, Perth<br>ALS Minerals, Townsville<br>Bureau Veritas Amdel, Adelaide<br>Bureau Veritas Amdel, Kalgoorlie<br>Intertek Genalysis Laboratory Services, Perth |
| **Burkina Faso** | ALS Minerals, Burkina Faso<br>SEMAFO Burkina Faso S.A. |
| **Canada** | Acme Analytical Laboratories, Vancouver<br>ALS Minerals, Val-d'Or<br>ALS Minerals, Vancouver<br>Bourlamaque, Quebec<br>Loring Laboratories (Alberta) Ltd, Calgary<br>SGS Minerals Services, Lakefield, Ontario<br>SGS Minerals Services, Vancouver<br>Techni-Lab S.G.B. Abitibi Inc/Actlabs, Val d'Or<br>Techni-Lab S.G.B. Abitibi Inc/Actlabs, Ste-Germaine-Boule<br>TSL Laboratories Inc, Saskatoon |
| **Chile** | Acme Analytical Laboratories, Santiago |
| **Côte d'Ivoire** | Bureau Veritas Mineral Laboratories, Abidjan |
| **Ghana** | ALS Minerals, Kumasi<br>SGS Performance Lab, Obuasi AngloGold |
| **Ireland** | ALS Minerals, Loughrea |
| **Kyrgyz Republic** | Stewart Assay and Environmental Laboratories LLC, Kara-Balta |
| **Laos** | ALS Geochemistry, Vientiane |
| **Mali** | ALS Minerals, Bamako |
| **Mongolia** | ALS Minerals, Ulaanbaatar |
| **Namibia** | Bureau Veritas- Mineral Laboratories, Swakopmund |
| **New Zealand** | SGS New Zealand Ltd, Otago<br>SGS New Zealand Ltd, Reefton<br>SGS New Zealand Ltd, Waihi |
| **Peru** | ALS Minerals, Lima<br>Inspectorate Services Perú S.A.C., Callao<br>Minera Yanacocha SRL – Newmont, Lima |
| **Romania** | ALS Minerals, Rosia Montana |
| **Russia** | Irgiredmet Analytical Centre, Irkutsk |
| **South Africa** | AB Analytical Laboratory Services, Boksburg<br>Acme, Inspectorate M & M, Rustenburg<br>ALS Minerals, Edenvale<br>SibanyeGold, Driefontein Operations<br>Performance Laboratories, Barberton<br>Performance Laboratories, Randfontein<br>Performance Laboratories, Allanridge |
| **Turkey** | Acme Analitik Laboratuar Hizmetleri Ltd, Sirketi<br>ALS Minerals, Izmir |
| **USA** | ALS Minerals, Reno<br>Barrick Goldstrike – Met Services, Nevada<br>Inspectorate, Sparks<br>Newmont Mining Corporation, Carlin<br>Newmont Mining Corporation, Lone Tree<br>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 in the past have misinterpreted this confidence interval as a guide as to how different an individual test result should be from the declared value. Some mistakenly use this interval, or the standard deviation from the consensus test, to set limits for control charts on their own routine test results using the reference material. 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.

A much better way of determining the laboratory performance when analysing the reference material is to accumulate a history of the test results obtained, and plot them on a control chart. The appropriate centre line and control limits for this chart should be based on the average level and variability 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.

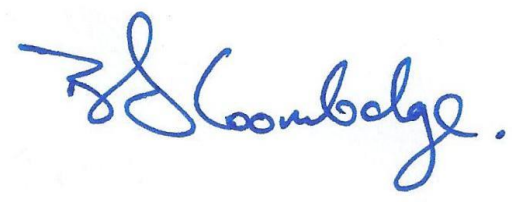
**Legal Notice:**

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 Brett Coombridge.

**Certifying Officer**



Brett Coombridge (M.Phil. Chemistry)

**Independent Statistician**

**Tim Ball BSc (Hons)**