

Certificate of Analysis

Reference Material SP27

Recommended Values and 95% Confidence Intervals

Gold Concentration: 18.10 (+/- 0.27) µg/g

Silver Concentration: 58.38 (+/- 2.03) µg/g

The above values apply only to product in jars or sachets which have an identification number within the following range: **103 390 to 104 683.**

Prepared and Certified By:

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Date of Certification:

19 December 2005

Certificate Status:

Original

Available Packaging:

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

Origin of Reference Material:

Feldspars 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 Ltd
P O Box 18 142
Auckland
NEW ZEALAND
Email: sales@rocklabs.com
Telephone: +64 9 634 769

Description:

The component minerals have been well mixed and a homogeneity test carried out after the entire batch was packaged into wide-mouthed jars to ascertain that the gold is evenly distributed throughout the reference material. 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	62.36
Al ₂ O ₃	17.49
Na ₂ O	6.85
K ₂ O	4.93
CaO	0.17
MgO	0.14
TiO ₂	0.03
MnO	0.02
P ₂ O ₅	0.12
Fe	3.7
S	3.5

Intended Use:

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

Stability:

The container (jar or sachet) and its contents should not be heated to temperatures higher than 50 °C. Iron pyrites are likely to oxidize in the air but preliminary 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:

Pulverized feldspar minerals and barren iron pyrites were blended with finely pulverized and screened, gold and silver-containing minerals. Once the powders were uniformly mixed the composite was placed into 1294 wide-mouthed jars, each bearing a unique number. 40 jars were randomly selected from the packaging run and material from these jars was used for both homogeneity and consensus testing.

Homogeneity Assessment:

An independent laboratory carried out gold analysis by fire assay of 30g portions, using a gravimetric finish with a balance capable of reading to one microgram. Steps were taken to minimize laboratory method variation in order to better detect any variation in the reference material.

Homogeneity Assessment After Packaging

The contents of five of the randomly selected jars were compacted by vibration (to simulate the effect of freighting) and five samples removed successively from top to bottom from each of the five jars. In addition, five samples were removed from the last jar in the series. 40 samples were removed from the top of 40 jars randomly selected from the 1294 jars in the batch. The results of analysis of the 70 samples produced a coefficient of variation of 0.4%.

As the homogeneity testing was carried out using 30g analytical portions, the same degree of homogeneity cannot be guaranteed for gold if smaller weights are taken for analysis.

Analytical Methodology:

Once homogeneity had been established, eight 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 40 randomly selected jars with each laboratory receiving sub-samples from eight different jars. Indicative concentration ranges were given. The laboratories were selected on the basis of good performance for high gold and wide-range silver in previous consensus rounds we have carried out.

Calculation of Certified Value:

12 sets of results for gold were returned from 12 laboratories and 9 sets of results for silver were returned from 8 laboratories. Statistical analysis to identify outliers for both within and between laboratories was carried out using the principles detailed in sections 7.3.2 – 7.3.4, ISO 5725-2: 1994. Details of the criteria used in these examinations are available on request. As a result of these statistical analyses, one individual gold result from one laboratory was excluded and the remaining results were used to assign gold and silver concentration values to this reference material. The recommended values were thus calculated from the average of the $n = 12$ sets of replicate results for gold and $n = 9$ sets of replicate results for silver. The 95% confidence intervals were 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 for both gold and silver are provided at the beginning of the certificate in $\mu\text{g/g}$ (ppm) units. Summaries of the results used to calculate the recommended values are listed on page 4 and the names of the laboratories that submitted results are listed on page 5.

Summary of Results Used to Calculate Gold Value

(in order of laboratory average, not related to order of laboratories listed on page 5)

Lab	Method									Laboratory Average ppm	Within Laboratory standard deviation ppm	Within Laboratory coefficient of variation %
1	fa/AAS	17.3	17.2	17.0	17.4	17.4	17.0	17.0	17.1	17.175	0.175	1.02%
2	fa/AAS	17.4	17.6	18.2	17.4	18.0	17.6	17.6	17.4	17.650	0.298	1.69%
3	fa/grav	18.05	17.95	17.35	17.9	18.2	18.1	18.05	17.75	17.919	0.267	1.49%
4	fa/grav	17.98	17.95	17.95	18.05	18.05	17.95	18.15	17.98	18.006	0.072	0.40%
5	fa/grav	18.27	18.00	18.09	18.07	18.12	18.05	18.09	18.17	18.107	0.084	0.46%
6	fa/grav	18.2	18.1	18.05	18.15	18.2	18.25	18.1	18.1	18.144	0.068	0.37%
7	fa/grav	18.352	18.346	18.141	18.112	18.175	18.098	18.109	18.174	18.188	0.103	0.57%
8	fa/AAS	18.140	18.110	18.180	18.250	18.250	18.190	18.250	18.250	18.203	0.056	0.31%
9	fa/grav	18.4	18.1	18.3	18.4	18.2	18.35	18.2	18.0	18.244	0.145	0.79%
10	fa/grav	18.38	18.45	18.45	18.31	18.10	18.17	18.17		18.290	0.144	0.79%
11	fa/grav	18.40	18.40	18.46	18.30	18.36	18.36	18.44	18.38	18.388	0.050	0.27%
12	fa/AAS	19.10	18.55	19.05	19.00	19.45	19.00	19.05	18.50	18.963	0.307	1.62%
Overall Mean										18.104		
Between Laboratory Standard Deviation											0.429	
Between Laboratory Coefficient of Variation												2.37%

Summary of Results Used to Calculate Silver Value

(in order of laboratory average, not related to order of laboratories listed on page 5)

Lab	Method									Laboratory Average ppm	Within Laboratory standard deviation ppm	Within Laboratory coefficient of variation %
1	ar/AAS	54.3	55.1	53.1	55.2	54.7	54.9	56.1	56.3	54.963	1.010	1.84%
2	multi-acid/AAS	56	55	57	56	56	54	55	57	55.750	1.035	1.86%
3	4acid/AAS	56.5	57	56	57	55	57	53	56	55.938	1.374	2.46%
4	HNO ₃ /Br ₂ /HCl/AAS	57.9	57.2	57.6	56.5	58.1	59.4	57.7	58.5	57.863	0.863	1.49%
5	AAS	57	59	59	58	57	58	56	60	58.000	1.309	2.26%
6	grav	58	59	58	60	59	59	59	59	58.875	0.641	1.09%
7	ar/AAS	59.6	59.7	59.9	60.1	60.3	59.6	60.1	59.8	59.888	0.259	0.43%
8	ar/ICP-ES	59	61	60	62	60	61	61	66	61.250	2.121	3.46%
9	fa/grav	58	62	64	64	61	68	64	62	62.875	2.900	4.61%
Overall Mean										58.378		
Between Laboratory Standard Deviation											2.644	
Between Laboratory Coefficient of Variation												4.53%

Statistical analysis of both homogeneity and consensus test results has been carried out by independent statistician, Tim Ball.

Participating Laboratories

Acme Analytical Laboratories Ltd, British Columbia
ALS Chemex, British Columbia
ALS Chemex, Nevada
ALS Chemex, Quebec
Amdel Laboratories, Perth
Barrick Goldstrike Mines Inc, Nevada
Bourlamaque Assay Laboratories Ltd, Quebec
Mintek, Analytical Services Division, South Africa
OMAC Laboratories Ltd, Ireland
SGS Australia, Perth
SGS Lakefield Research Africa (Pty) Ltd, South Africa
SGS New Zealand Ltd, Waihi
Standard and Reference Laboratories, Perth

Instructions and Recommendations for Use:

Weigh out quantity usually used for analysis and analyze for total gold by normal procedure. Homogeneity testing has shown that consistent results are obtainable for gold when 30g portions are taken for analysis. Homogeneity cannot be guaranteed for gold if smaller weights are taken for analysis. 1g portions are suitable for silver 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 (or 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 testing.

Some customer laboratories in the past have misinterpreted this confidence interval as an indication of how different their own test result will be from the declared value. Some even mistakenly use this interval 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. ISO 5725 - Accuracy (trueness and precision) of measurement methods and results, is the international standard that we use to design and analyse the interlaboratory trials for characterizing our reference materials. This standard defines two estimates of variability that will be indicative of the variations a reasonable laboratory might experience using the reference material.

The two sources of variability are:-

1) Repeatability – the variation between single results of the same material, tested at the same time, under the same conditions. This is estimated from the pooled within laboratory variation from the trial (ie the variation between the 8 different samples of the same reference material, tested at the same time). Our estimate of the approximate 95% Repeatability Confidence Interval from this trial is +/- 0.345 ppm for gold and +/- 2.966 ppm for silver. This figure may have limited value in this exercise, where not all laboratories used the same analytical method and we observed significant differences in repeatabilities between the laboratories.

2) Reproducibility – the variation between single results of the same material, tested by different laboratories, at possibly different times, and possibly different conditions. This is estimated from the between laboratory component of variation from this trial, combined with the repeatability measure defined above. This is a useful indicator of how far from the declared value a **single value** from a good laboratory, similar to those included in this study, might vary. Our estimate of the approximate 95% Reproducibility Confidence Interval from this trial is +/- 1.008 ppm for gold and +/- 6.887 ppm for silver.

Note: A much better way of determining the laboratory performance for testing 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 more simply for themselves, 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, Malcolm Smith Reference Materials 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 Malcolm Smith.

Certifying Officer

Independent Statistician



M G Smith BSc, FNZIC

Tim Ball BSc (Hons)