



ROCKLABS

WORLD LEADERS IN SAMPLE PREPARATION EQUIPMENT AND REFERENCE MATERIALS FOR USE IN GOLD ASSAYING

ROCKLABS LIMITED

161 NEILSON STREET, ONEHUNGA, PO BOX 18-142, GLEN INNES, AUCKLAND, NEW ZEALAND

Tel: +64 9 634 7696

Fax: +64 9 634 6896

Email: sales@rocklabs.com

Website: www.rocklabs.com

Certificate of Analysis

Reference Material SQ47

Recommended Values and 95% Confidence Intervals

Gold Concentration: 39.88 (+/- 0.29) µg/g

Silver Concentration: 122.3 (+/- 2.3) µg/g

The above values apply only to product in jars or sachets which have an identification number within the following range: **188 243 – 189 154**.

Prepared and Certified By:

Malcolm Smith BSc, FNZIC
Malcolm Smith Reference Materials Ltd
40 Oakford Park Crescent, Greenhithe
North Shore City 0632
NEW ZEALAND
Email: Malcolm@MSRML.co.nz
Telephone: +64 9 444 3534

Date of Certification:

19 June 2009

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 Ltd
P O Box 18 142
Auckland 1743
NEW ZEALAND
Email: sales@rocklabs.com
Website: www.rocklabs.com
Telephone: +64 9 634 7696

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	49.86
Al ₂ O ₃	12.28
Na ₂ O	3.85
K ₂ O	3.05
CaO	3.04
MgO	2.65
TiO ₂	0.72
MnO	0.05
P ₂ O ₅	0.22
Fe ₂ O ₃	3.2
Fe	9.0
S	10.0

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 tests have shown that the increase in weight of an exposed reference material of similar matrix, in the Auckland climate, is less than 0.3 % per year.

Method of Preparation:

Pulverized feldspar minerals, basalt rock 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 912 wide-mouthed jars, each bearing a unique number. 21 jars were randomly selected from the packaging run and material from these jars was used for both homogeneity assessment and assignment of gold and silver values.

Homogeneity Assessment for Gold:

An independent laboratory carried out all gold analyses by fire assay of 30 g portions, using a gravimetric finish. The homogeneity assessment was carried out after the material had been packaged into jars.

Homogeneity Assessment for Gold continued:

The contents of two randomly selected jars were compacted by vibration (to simulate the effect of freighting) and five samples removed successively from top to bottom from each jar. In addition, five samples were removed from the last jar in the series. A sample was also removed from the top of each of the 21 jars randomly selected from the 912 jars in the batch. The results of analysis of the 36 samples (randomly ordered and then consecutively numbered before being sent to the laboratory) produced a relative standard deviation of 1.6 %.

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 21 randomly selected jars and each laboratory received samples from two different jars. Indicative concentration ranges were given. All laboratories used fire assay for the gold analysis, with some using an instrument finish and some a gravimetric finish. A number of different analytical procedures were used for the silver analyses.

Calculation of Certified Value:

40 laboratories returned results for gold and 27 for silver. 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, five sets of results were excluded for the purpose of assigning a gold concentration value and nil sets were excluded for silver.

Recommended values were thus calculated from the average of the remaining $n = 35$ sets of replicate results for gold and $n = 27$ 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 $\mu\text{g/g}$ (ppm) units. A summary of the results used to calculate the recommended value is listed on page 4 for silver and page 5 for gold. 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. A code also indicates the method used by the laboratory. The code starts with the sample weight used (where this is known) and finishes with either the instrument used (eg AAS or ICP-OES) or gravimetric finish (indicated by "grav"). Codes for the digestions are: fa = fire assay; Hfar = hydrofluoric acid and aqua regia; ar = aqua regia; 4ac = 4 acids: hydrofluoric, perchloric, nitric, hydrochloric; 3ac = 3 acids: perchloric, aqua regia. Statistical analysis for gold was carried out separately on two groups of samples – those analysed with an instrument finish and those completed by gravimetry. There was no significant difference in the calculated gold average for each group. This applied with outliers included as well as with outliers excluded. Therefore the assigned value was

calculated from the combined sets of results. No statistical examination was carried out to determine whether there was any significant difference obtained for silver by the different methods used.

Independent statistician, Tim Ball, has carried out statistical analysis of the consensus test results.

Summary of Results Used to Calculate Silver Value (Listed in increasing order of individual laboratory averages)

Silver (ppm)			
Method	Sample 1	Sample 2	Average
25gfa/grav	106.4	108.5	107.45
2gHFar/AAS	110	110	110.0
30gfa/grav	115.225	115.950	115.588
ar/AAS	114.00	117.38	115.690
30gfa/grav	121	111	116.0
0.5g4ac/AAS	120	118	119.0
0.3g4ac/AAS	118	120	119.0
fa/grav	119.73	120.67	120.200
0.4g4ac/ICP-AES	117	125	121.0
0.2gBr2,HNO3,HCl/ICP-OES	126	116	121.0
4ac/ICP-MS	121	122	121.5
0.5g4ac/AAS	123.5	120.7	122.10
ar/AAS	121.09	124.91	123.000
30gfa/grav	123	124	123.5
30gfa/grav	124	124	124.0
2g4ac/AAS	125	123	124.0
1g3ac/AAS	124	124	124.0
30gfa/grav	125	123	124.0
0.5gHFar/AAS	123.05	127.0	125.025
30gfa/grav	128.2	124.0	126.10
15gfa/grav	123.60	128.87	126.235
1gar/AAS	126	128	127.0
ar/AAS	123	131	127.0
1gar/AAS	130	126	128.0
ar/AAS	132	127	129.5
0.4gar/AAS	132	128	130.0
0.2g4ac/AAS	131	131	131.0
Average of 27 sets = 122.3 ppm			
Standard deviation of 27 sets = 5.7 ppm			
<i><u>Note: this standard deviation should not be used as a basis to set control limits when plotting results from an individual laboratory.</u></i>			
Relative standard deviation = 4.7 %			
95% Confidence interval for average = 2.3 ppm			

Summary of Results Used to Calculate Gold Value
(Listed in increasing order of individual laboratory averages)

Gold (ppm)			
Method	Sample 1	Sample 2	Average
30gfa/AAS	37.9	37.8	37.85
25gfa/ICP	38.4	37.9	38.15
30gfa/grav	38.650	38.71	38.680
50gfa/AAS	38.4	39.1	38.75
30gfa/grav	38.95	38.88	38.915
30gfa/AAS	39.30	38.80	39.050
30gfa/AAS	38.1	40.1	39.10
fa/grav	39.05	39.40	39.225
50gfa/AAS	38.3	40.2	39.25
20gfa/AAS	39.7	39.0	39.35
25gfa/grav	39.6	39.5	39.55
30gfa/grav	40.2	39.2	39.70
30gfa/AAS	39.6	39.8	39.70
15gfa/grav	39.91	39.53	39.720
fa/AAS	39.933	40.117	40.025
30gfa/AAS	40.058	40.075	40.067
fa/grav	39.844	40.315	40.080
10gfa/AAS	40.335	39.865	40.100
30gfa/grav	40.00	40.20	40.100
30gfa/grav	40.18	40.03	40.105
fa/grav	40.067	40.167	40.117
30gfa/grav	40.143	40.146	40.145
30gfa/grav	40.2	40.1	40.15
30gfa/AAS	40.25	40.06	40.155
fa/grav	40.06	40.46	40.260
fa/grav	40.267	40.333	40.300
30gfa/grav	40.30	40.36	40.330
40gfa/ICP-OES	41.05	39.65	40.350
30gfa/grav	40.2	40.6	40.40
30gfa/grav	40.4	40.5	40.45
30gfa/grav	40.69	40.51	40.600
15gfa/grav	40.337	41.040	40.689
30gfa/AAS	41.0	41.0	41.00
10gfa/AAS	41.45	41.11	41.280
30gfa/AAS	42.2	42.1	42.15
Average of 35 sets = 39.88 ppm Standard deviation of 35 sets = 0.85 ppm			
<i>Note: this standard deviation should not be used as a basis to set control limits when plotting results from an individual laboratory.</i>			
Relative standard deviation = 2.1 % 95% Confidence interval for average = 0.29 ppm			

Participating Laboratories

Australia	ALS Chemex, Kalgoorlie ALS Chemex, Perth Amdel Ltd, Adelaide Amdel Ltd, Kalgoorlie Genalysis Laboratory Services Pty Ltd, Perth SGS Australia Pty Ltd, Perth SGS Australia Pty Ltd, Townsville Standard and Reference Laboratories, Perth Ultra Trace Pty Ltd, Perth
Burkina Faso	ALS Chemex, Ouagadougou
Canada	Accurassay Laboratories, Thunder Bay Acme Analytical Laboratories Ltd, Vancouver ALS Chemex, Val d'Or ALS Chemex, Vancouver Assayers Canada, Vancouver Bourlamaque Assay Laboratories Ltd, Val d'Or International Plasma Labs Ltd, Richmond Loring Laboratories Ltd, Calgary SGS Mineral Services, Lakefield Techni-Lab S.G.B. Abitibi Inc, Quebec TSL Laboratories Inc, Saskatoon
Chile	Acme Analytical Laboratories Ltd, Santiago
Kyrgyzstan	Alex Stewart Assay and Environmental Laboratories Ltd, Kara-Balta
Mali	ALS Chemex, Bamako
New Zealand	Amdel NZ Ltd, Macraes, Otago Amdel Ltd, Reefton SGS Minerals, Waihi
Peru	ALS Chemex, Lima Minera Yanacocha SRL – Newmont, Lima Inspectorate Services Peru S.A.C., Callao
Russia	Irgiredmet JSC, Analytical Centre, Irkutsk
South Africa	AB Analytical Laboratory Services, Boksburg Anglo Research, Johannesburg Performance Laboratories, Randfontein SGS South Africa (Pty) Ltd, Barberton SGS South Africa (Pty) Ltd, Southdale
United States of America	ALS Chemex, Reno Barrick Goldstrike Mines Inc, Carlin Newmont Mining Corporation, Carlin Laboratory Newmont Mining Corporation, Lone Tree Laboratory

Instructions and Recommendations for Use:

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

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 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 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



M G Smith BSc, FNZIC

Independent Statistician



Tim Ball BSc (Hons)