AMIS0908

Reference Material

Blank Silica Chips

Reference Material Report

AMIS
A: 11 Avalon Road, West Lake View, Ext 11, Modderfontein, 1609, South Africa
T: +27 (0) 11 923 0800
W: www.amis.co.za

Table of Contents

List of Tables

Summary Statistics

Informational Values

Analyte	Method	[7]Mean	[9]±Two Standard Deviations (2s)	Unit
Au	[1] NiS	<5	**	ppb
Ir	NiS	3	1	ppb
Os	NiS	<2	**	ppb
Pd	NiS	3	2	ppb
Pt	NiS	4	7	ppb
Rh	NiS	1	*	ppb
Ru	NiS	2	*	ppb
C	[2] Combustion/LECO	<0.01	**	%
S	Combustion/LECO	0.01	*	%
S	[3] 4A_MICP	<0.05	**	%
LOI	[4] LOI	0.4	0.07	%
SG	[5] SG	3	0.04	No unit
Ag	4A_MICP	<0.05	**	ppm
Al	4A_MICP	3267	226	ppm
As	4A_MICP	<0.5	**	ppm
Ba	4A_MICP	21	2	ppm
Be	4A_MICP	0.1	0.03	ppm
Bi	4A_MICP	<0.01	**	ppm
Ca	4A_MICP	286	76	ppm
Cd	4A_MICP	0.06	0.03	ppm
Ce	4A_MICP	9	1	ppm
Co	4A_MICP	0.1	0.08	ppm
Cr	4A_MICP	4	2	ppm
Cs	4A_MICP	0.2	0.02	ppm
Cu	4A_MICP	2	1	ppm
Fe	4A_MICP	0.03	0.01	%
Ga	4A_MICP	0.4	0.07	ppm
Ge	4A_MICP	0.7	0.1	ppm
Hf	4A_MICP	15	4	ppm
In	4A_MICP	<0.01	**	ppm
K	4A_MICP	465	55	ppm
La	4A_MICP	4	0.5	ppm
Li	4A_MICP	3	0.2	ppm
Mg	4A_MICP	62	33	ppm
Mn	4A_MICP	10	2	ppm
Mo	4A_MICP	<0.1	**	ppm
Na	4A_MICP	228	21	ppm
Nb	4A_MICP	0.2	0.05	ppm
Ni	4A_MICP	0.9	0.4	ppm
P	4A_MICP	<50	**	ppm
Pb	4A_MICP	4	0.2	ppm
Rb	4A_MICP	2	0.4	ppm
Re	4A_MICP	<0.002	**	ppm
Sb	4A_MICP	0.1	0.03	ppm
Sc	4A_MICP	0.8	0.2	ppm
Se	4A_MICP	<0.5	**	ppm
Sn	4A_MICP	0.1	0.06	ppm
Sr	4A_MICP	34	2	ppm
Ta	4A_MICP	0.02	0.01	ppm
Te	4A_MICP	<0.2	**	ppm
Th	4A_MICP	3	0.3	ppm
Ti	4A_MICP	124	12	ppm
Tl	4A_MICP	0.02	*	ppm
U	4A_MICP	0.8	0.1	ppm
V	4A_MICP	4	3	ppm
W	4A_MICP	<0.1	**	ppm
Y	4A_MICP	2	0.1	ppm
Zn	4A_MICP	5	3	ppm
Zr	4A_MICP	730	209	ppm

Major Oxides
Informational Values

Analyte	Method	[7]Mean	[9]±Two Standard Deviations (2s)	Unit
Al_2O_3	[6] XRF	0.6	0.07	%
CaO	XRF	0.04	0.04	%
Cr_2O_3	XRF	<0.01	**	%
Fe_2O_3	XRF	<0.01	**	%
K_2O	XRF	0.06	0.01	%
MgO	XRF	0.02	0.02	%
MnO	XRF	<0.01	**	%
Na_2O	XRF	0.02	0.009	%
P_2O_5	XRF	<0.002	**	%
SiO_2	XRF	98.64	0.3	%
SO_3	XRF	<0.01	**	%
TiO_2	XRF	0.04	0.01	%

Disclaimer:
AMIS removes any foreign material prior to packaging. However please scan material prior to use. If you need any clarification on this statement, please contact AMIS.

1. Mean Concentrations and Uncertainties

AMIS0908 is a new reference material and developed in September 2023. Table 1 gives the recommended concentrations, Standard Deviation, Two Standard deviations, and Relative Stand Deviation. Table 2 shows the recommended concentrations, Standard Deviation, Two Standard deviations and Relative Stand Deviation.

Table 1. Recommended concentrations, Standard Deviation, Two Standard deviations and Relative Stand Deviation.

Analyte	Method	[7]Mean	[8]±Standard Deviation (s)	[9]±Two Standard Deviations (2s)	[10]% RSD	Unit
Au	[1] NiS	<5	[11] **	**	**	ppb
Ir	NiS	3	0.6	1	21	ppb
Os	NiS	<2	**	**	**	ppb
Pd	NiS	3	0.9	2	32	ppb
Pt	NiS	4	3	7	83	ppb
Rh	NiS	1	[12] *	*	*	ppb
Ru	NiS	2	*	*	*	ppb
C	[2] Combustion/LECO	<0.01	**	**	**	%
S	Combustion/LECO	0.01	*	*	*	%
S	[3] 4A_MICP	<0.05	**	**	**	%
LOI	[4] LOI	0.4	0.03	0.07	9	%
SG	[5] SG	3	0.02	0.04	0.7	No unit
Ag	4A_MICP	<0.05	**	**	**	ppm
Al	4A_MICP	3267	113	226	3	ppm
As	4A_MICP	<0.5	**	**	**	ppm
Ba	4A_MICP	21	1	2	5	ppm
Be	4A_MICP	0.1	0.01	0.03	12	ppm
Bi	4A_MICP	<0.01	**	**	**	ppm
Ca	4A_MICP	286	38	76	13	ppm
Cd	4A_MICP	0.06	0.01	0.03	20	ppm
Ce	4A_MICP	9	0.5	1	6	ppm
Co	4A_MICP	0.1	0.04	0.08	35	ppm
Cr	4A_MICP	4	0.9	2	20	ppm
Cs	4A_MICP	0.2	0.01	0.02	8	ppm
Cu	4A_MICP	2	0.5	1	26	ppm
Fe	4A_MICP	0.03	0.007	0.01	20	%
Ga	4A_MICP	0.4	0.03	0.07	8	ppm
Ge	4A_MICP	0.7	0.05	0.1	8	ppm
Hf	4A_MICP	15	2	4	14	ppm
In	4A_MICP	<0.01	**	**	**	ppm
K	4A_MICP	465	27	55	6	ppm
La	4A_MICP	4	0.3	0.5	6	ppm
Li	4A_MICP	3	0.1	0.2	4	ppm
Mg	4A_MICP	62	17	33	27	ppm
Mn	4A_MICP	10	1	2	10	ppm
Mo	4A_MICP	<0.1	**	**	**	ppm
Na	4A_MICP	228	10	21	5	ppm
Nb	4A_MICP	0.2	0.03	0.05	13	ppm
Ni	4A_MICP	0.9	0.2	0.4	22	ppm
P	4A_MICP	<50	**	**	**	ppm
Pb	4A_MICP	4	0.1	0.2	3	ppm
Rb	4A_MICP	2	0.2	0.4	9	ppm
Re	4A_MICP	<0.002	**	**	**	ppm
Sb	4A_MICP	0.1	0.01	0.03	11	ppm
Sc	4A_MICP	0.8	0.1	0.2	11	ppm
Se	4A_MICP	<0.5	**	**	**	ppm
Sn	4A_MICP	0.1	0.03	0.06	28	ppm
Sr	4A_MICP	34	1	2	3	ppm
Ta	4A_MICP	0.02	0.006	0.01	26	ppm
Te	4A_MICP	<0.2	**	**	**	ppm
Th	4A_MICP	3	0.1	0.3	5	ppm
Ti	4A_MICP	124	6	12	5	ppm
Tl	4A_MICP	0.02	*	*	*	ppm
U	4A_MICP	0.8	0.07	0.1	9	ppm
V	4A_MICP	4	2	3	39	ppm
W	4A_MICP	<0.1	**	**	**	ppm
Y	4A_MICP	2	0.07	0.1	4	ppm

Table 1. Recommended concentrations, Standard Deviation, Two Standard deviations and Relative Stand Deviation. (Continued)

Analyte	Method	[7]Mean	[8]±Standard Deviation (s)	[9]±Two Standard Deviations (2s)	[10]% RSD	Unit
Zn	4A_MICP	5	1	3	25	ppm
Zr	4A_MICP	730	104	209	14	ppm

Table 2. Recommended concentrations, Standard Deviation, Two Standard deviations and Relative Stand Deviation.

Analyte	Method	[7]Mean	[8]±Standard Deviation (s)	[9]±Two Standard Deviations (2s)	[10]% RSD	Unit
Al_2O_3	[6] XRF	0.6	0.04	0.07	6	%
CaO	XRF	0.04	0.02	0.04	48	%
Cr_2O_3	XRF	<0.01	**	**	**	%
Fe_2O_3	XRF	<0.01	**	**	**	%
K_2O	XRF	0.06	0.005	0.01	8	%
MgO	XRF	0.02	0.008	0.02	52	%
MnO	XRF	<0.01	**	**	**	%
Na_2O	XRF	0.02	0.005	0.009	20	%
P_2O_5	XRF	<0.002	**	**	**	%
SiO_2	XRF	98.64	0.2	0.3	0.2	%
SO_3	XRF	<0.01	**	**	**	%
TiO_2	XRF	0.04	0.005	0.01	14	%

1. *NiS is Nickel Sulphide with either ICPOES/ICPMS/AAS finish*
2. *Combustion/LECO*
3. *4A_MICP is a Four-acid digestion with either ICPOES/ICPMS/AAS finish*
4. *LOI is Loss On Ignition*
5. *SG is Specific Gravity*
6. *XRF is X-ray Fluorescence*
7. *Mean is the average of results received*
8. *Standard Deviation (s)*
9. *Two standard deviations (2s)*
10. *% RSD is Relative Standard Deviation in percentage*
11. *** denotes that the element/oxide was not detected and s, 2s and %RSD could not be calculated*
12. *** denotes that the results were too similar and s, 2s and %RSD could not be calculated*

2. Intended Use

AMIS0908 is a Reference Material, fit for use as a control sample in routine assay laboratory quality control when inserted within runs of test samples and measured in parallel to test samples. The reference material is to be used only for internal quality control. The values quoted herein are not certified.

3. Analytical and Physical Methods

A complete list of analytical and physical methods as generic method codes with a brief description of the methods is available on the AMIS web site www.amis.co.za.

4. Origin of Material

This standard was made from silica chips and the material was sourced in South Africa.

5. Approximate Mineral and Chemical Composition

The material is a silica blank chips which typically contains > 95% SiO_2.

6. Quantitative Analysis by X-Ray Diffraction

Both natural and synthetic materials have a specific chemistry and atomic arrangement, known as phases. Phases can be identified and quantified using X-ray diffraction (XRD) which produces a plot of the intensity of X-rays scattered at different angles by crystalline phases in a material. Essentially, an X-ray diffraction pattern is the sum of the diffraction patterns produced by each phase. Simply put, an X-ray diffraction pattern is a fingerprint that allows the identification of what is in a target sample material. Knowledge of the mineral phase composition is useful in method development with techniques such as ICP-OES and XRF as potential matrix effects and spectral interferences can be recognized and accounted for. X-ray diffraction is effective in such a way that it allows the identification of different phases of compounds that are identical in chemistry, but have distinctly different atoms, e.g., quartz, cristobalite, and glass are all different phases of SiO_2. Where quantitative XRD results do not correspond to results of other analytical techniques, it should be borne in mind that even though the data are quantitative they are meant to be used for indicative purposes in development of other analytical methods. Mineral names may not reflect the actual compositions of minerals identified, but rather the mineral group.

Quantification is determined from the chosen software package: this uses the full-profile Rietveld method of refining the profile of the calculated XRD pattern against the profile of the measured XRD pattern. The total calculated pattern is the sum of the calculated patterns of the individual phases. Results are given as weight % of the total crystalline phases and amorphous content. The amorphous content quantifies the amorphous material and unknown minerals or known minerals for which there is not a suitable crystal structure.

Corrections are incorporated into the process that allows for a more accurate description of the mineral's contribution to the measured pattern and to allow for variation due to atomic substitution, layer disordering, preferred orientation, and other factors that affect the acquisition of the XRD scan.

The limitations of qualitative XRD analysis are as follows:

- The detection of a phase may be dependent on its crystallinity.
- Where there exist multiple phases, overlap of diffracted reflections can occur, thus rendering some ambiguity into the interpretation.
- Overlapping reflections of a major phase can mask the presence of minor or trace phases.
- Some phases cannot be unambiguously identified as they are present in minor or trace amounts.

The limitations of quantitative XRD analysis by a full-profile Rietveld method are as follows:

- The limitations for qualitative XRD analysis apply.
- The method as described is standardless: it relies solely on the published crystallographic data available for each phase. Some data may not exactly describe the phases present.
- Particle size is important with respect to the absorption of the X-rays by the sample.
- Micronizing reduces the particle size to that more suitable for quantitative analysis.

The accuracy of the analysis is dependent on sampling and sample preparation in addition to the calculated profiles being exactly representative of the chemistry of the component phases and their crystallinity. Some preferred orientation effects and reflection overlaps may occur which cannot be adequately resolved.

Table 3. Results of XRD analysis.

Phase	Formula	Unit	Composite
Amorphous Content*		wt%	2
Kaolin**	$Al_2Si_2O_5(OH)_4$	wt%	<0.5
Mica**	$(K,Ca,Na,Li)(Al,Mg,Fe)_2(Si,Al)_4O_{10}(OH)_2$	wt%	1
Quartz	SiO_2	wt%	96
Total			99%

For informational purposes only

7. Health and Safety

The material is a very fine pale 10R 8/2 Greyish Orange Pink Reference Material. Safety precautions for handling fine particulate matter are recommended, such as the use of safety glasses, breathing protection, gloves and a laboratory coat.

8. Method of Preparation

The material was visually inspected for foreign objects, systematically divided and sealed into 1kg Laboratory Packs. Explorer Packs are then subdivided from the Laboratory Packs as required. Final packaged units were then selected on a random basis and submitted for analysis to an independent laboratory accredited with the ISO17025 standard of general requirements for the competence of testing and calibration laboratories. The material has a particle size of 3-5mm and is not homogeneous.

9. Particle Size Determination

The sample has been analysed using a Malvern Mastersizer 2000. Particles are passed through a focused laser beam that scatter light at an angle inversely proportional to their size. The intensity of light is measured and converted to a volume in particle size distribution. The results for this standard are presented in Table 4.

Table 4. Particle Size Determination by laser diffraction.

Size (µm)	Vol. Under %	Size (µm)	Vol. Under %	Size (µm)	Vol. Under %	Size (µm)	Vol. Under %
0.024	0	0.523	0.08	11.2	41.37	163.4	94.72
0.028	0	0.594	0.28	12.72	44.07	185.7	97.04
0.032	0	0.675	0.62	14.45	46.79	211	98.7
0.036	0	0.767	1.15	16.42	49.57	239.7	99.6
0.041	0	0.872	1.94	18.66	52.4	272.4	99.94
0.046	0	0.991	3	21.2	55.28	309.5	100
0.053	0	1.125	4.32	24.09	58.19	351.6	100
0.06	0	1.279	5.9	25	59.03	399.5	100
0.068	0	1.453	7.64	27.37	61.08	453.9	100
0.077	0	1.651	9.49	31.1	63.89	515.7	100
0.088	0	1.875	11.36	32	64.5	586	100
0.1	0	2.131	13.22	35.33	66.59	665.7	100
0.113	0	2.421	15.06	38	68.04	756.4	100
0.128	0	2.75	16.92	40.14	69.18	859.4	100
0.146	0	3.125	18.8	45.61	71.63	976.4	100
0.166	0	3.55	20.73	53	74.32	1109	100
0.188	0	4.034	22.68	58.88	76.12	1260	100
0.214	0	4.583	24.65	66.89	78.23	1432	100
0.243	0	5.207	26.66	76	80.42	1627	100
0.276	0	5.916	28.77	86.35	82.7	1848	100
0.314	0	6.722	31.02	98.11	85.01	2100	100
0.357	0	7.637	33.44	111.4	87.26	2386	100
0.405	0	8.677	36.01	126.6	89.58	2600	100
0.46	0	9.858	38.68	143.8	92.1		

For informational purposes only

10. Storage information

The material should be stored in a cool dry place, in such a way that it does not compromise the integrity of the RM. The material should be stored in conditions which will ensure it does not absorb moisture.

11. Methods of Analysis Requested

The following methods of analysis were requested:

a) Pt, Pd, Au, Rh, Ru, Ir: NiS collection, ICP-OES or ICP-MS
b) Multi element scan: Multi-acid total digestion, including HF, ICP-OES or ICP-MS
c) Major oxides and LOI-XRF fusion (Samples sent separately)
d) SG – gas pycnometer
e) S and C Combustion/LECO

12. Reported Values

This material has been carefully prepared and tested by a third-party independent ISO17025 accredited laboratory. The material was not submitted for interlaboratory proficiency testing.

13. Metrological Traceability

The values quoted herein are based on the consensus values derived from statistical analysis of the data from an inter-laboratory measurement program. Traceability to SI units is via the standards used by the individual laboratories the majority of which are accredited to the ISO17025 general requirements for the competence of testing and calibration laboratories and who have maintained measurement traceability during the analytical process.

14. Period of Validity

The certified values are valid for this product, while still sealed in its original packaging, until notification to the contrary. The stability of the material will be subject to continuous testing for the duration of the inventory. Should product stability become an issue, all customers will be notified and notification to that effect will be placed on the www.amis.co.za website.

15. Minimum Sample Size

Most of the laboratories reporting, used a 0.5g sample size for the ICP-OES and a 30g sample size for the fire assay. These are the recommended minimum sample sizes for the use of this material.

16. Availability

This product is available in Laboratory Packs containing 1kg of material and Explorer Packs containing custom weights (from *3*0g to 250g) of material. The Laboratory Packs are sealed bottles delivered in sealed foil pouches. The Explorer Packs contain material in standard geochem envelopes, nitrogen flushed, and vacuum sealed in foil pouches.

17. Recommended use in Quality Control

Users should set their own limits *i.e.,* 1, 2 and 3 standard deviations from an obtained mean value based on at least 10 replicate analyses using this RM.

18. Legal Notice

This certificate and the reference material described in it have been prepared with due care and attention. However, AMIS and Melesha Gopi Mungaroo accept no liability for any decisions or actions taken following the use of the reference material.

Date of Version v1.00: 04 October 2023

Version: v1.00

Reason for Version v1.00: Addition of NiS, 4A_MICP and SG results

Version v1.00 replaces the original report of AMIS0908 Certification

Date of Version 000: 21 September 2023

Version: 000

Approving Officer:

African Mineral Standards: _____

Melesha Gopi Mungaroo (Senior Quality Specialist)