AMIS0926

Reference Material

Extrusive Basalt Blank

Reference Material Report

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Analyte	Method	[7]Mean	[9]± (2s)	Unit
SiO_2	[1] XRF	50.5	0.2	%
TiO_2	XRF	0.9	0.01	%
Al_2O_3	XRF	16.5	0.04	%
CaO	XRF	10.1	0.03	%
Cr_2O_3	XRF	0.05	<0.0001	%
Fe_2O_3	XRF	10.5	0.06	%
K_2O	XRF	0.6	0.008	%
MgO	XRF	6.4	0.05	%
MnO	XRF	0.2	*	%
Na_2O	XRF	2.4	0.01	%
P_2O_5	XRF	0.2	0.002	%
SO_3	XRF	0.2	0.008	%

Summary Statistics

Informational Values

Analyte	Method	[7]Mean	[9]± (2s)	Unit
Au	[2] NiS	4	1	ppb
Ir	NiS	<1	**	ppb
Os	NiS	<1	**	ppb
Pd	NiS	3	1	ppb
Pt	NiS	3	1	ppb
Rh	NiS	1	**	ppb
Ru	NiS	1	1	ppb
SG	[3] SG	2.9	0.05	No unit
C	[4] Combustion/LECO	0.1	0.01	%
S	Combustion/LECO	0.08	*	%
S	[5] 4A_MICP	0.1	0.02	%
LOI	[6] LOI	1.5	0.06	%
Ag	4A_MICP	0.06	0.01	ppm
Al	4A_MICP	85157	1137	ppm
As	4A_MICP	7	0.6	ppm
Ba	4A_MICP	193	4	ppm
Be	4A_MICP	0.5	0.03	ppm
Bi	4A_MICP	0.1	0.02	ppm
Ca	4A_MICP	72843	970	ppm
Cd	4A_MICP	0.1	0.04	ppm
Ce	4A_MICP	22	0.5	ppm
Co	4A_MICP	44	0.7	ppm
Cr	4A_MICP	300	42	ppm
Cs	4A_MICP	1	0.04	ppm
Cu	4A_MICP	116	3	ppm
Fe	4A_MICP	7.5	0.1	%
Ga	4A_MICP	19	0.5	ppm
Ge	4A_MICP	1	0.1	ppm
Hf	4A_MICP	2	0.1	ppm
In	4A_MICP	0.05	0.01	ppm
K	4A_MICP	4949	122	ppm
La	4A_MICP	11	0.2	ppm
Li	4A_MICP	12	0.4	ppm
Mg	4A_MICP	36407	692	ppm
Mn	4A_MICP	1202	19	ppm
Mo	4A_MICP	0.8	0.2	ppm
Na	4A_MICP	18131	379	ppm
Nb	4A_MICP	7	0.2	ppm
Ni	4A_MICP	97	1	ppm
P	4A_MICP	879	29	ppm
Pb	4A_MICP	4	0.3	ppm
Rb	4A_MICP	15	0.4	ppm
Re	4A_MICP	<0.002	**	ppm
Sb	4A_MICP	0.3	0.03	ppm
Sc	4A_MICP	28	0.9	ppm
Se	4A_MICP	<0.5	**	ppm
Sn	4A_MICP	0.8	0.6	ppm
Sr	4A_MICP	332	4	ppm
Ta	4A_MICP	0.4	0.01	ppm
Te	4A_MICP	<0.2	**	ppm
Th	4A_MICP	1	0.04	ppm
Ti	4A_MICP	5467	112	ppm
Tl	4A_MICP	0.1	0.02	ppm
U	4A_MICP	0.4	0.02	ppm
V	4A_MICP	198	5	ppm
W	4A_MICP	0.3	*	ppm
Y	4A_MICP	23	0.3	ppm
Zn	4A_MICP	86	2	ppm
Zr	4A_MICP	80	1	ppm

1. Mean Concentrations and Uncertainties

AMIS0926 is a new reference material and developed in February 2024. Table 1 shows the recommended concentrations for major oxides, Standard Deviation, Two Standard deviations, and Relative Standard Deviations. Table 2 shows the recommended concentrations, Standard Deviations, Two Standard deviations and Relative Standard Deviation.

Table 1. Recommended concentrations for major oxides, Standard Deviation, Two Standard deviations, and Relative Standard Deviation.

Analyte	Method	[7]Mean	[8]Standard Deviation (s) ±	[9]Two Standard Deviation (2s) ±	[10]%RSD	Unit
SiO_2	[1] XRF	50.5	0.08	0.2	0.2	%
TiO_2	XRF	0.9	0.005	0.01	0.6	%
Al_2O_3	XRF	16.5	0.02	0.04	0.1	%
CaO	XRF	10.1	0.01	0.03	0.1	%
Cr_2O_3	XRF	0.05	<0.0001	<0.0001	<0.0001	%
Fe_2O_3	XRF	10.5	0.03	0.06	0.3	%
K_2O	XRF	0.6	0.004	0.008	0.6	%
MgO	XRF	6.4	0.02	0.05	0.4	%
MnO	XRF	0.2	[11] *	*	*	%
Na_2O	XRF	2.4	0.007	0.01	0.3	%
P_2O_5	XRF	0.2	0.0008	0.002	0.4	%
SO_3	XRF	0.2	0.004	0.008	2	%

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

Analyte	Method	[7]Mean	[8]Standard Deviation (s) ±	[9]Two Standard Deviation (2s) ±	[10]%RSD	Unit
Au	[2] NiS	4	0.5	1	15	ppb
Ir	NiS	<1	[12] **	**	**	ppb
Os	NiS	<1	**	**	**	ppb
Pd	NiS	3	0.5	1	15	ppb
Pt	NiS	3	0.5	1	19	ppb
Rh	NiS	1	**	**	**	ppb
Ru	NiS	1	0.5	1	39	ppb
SG	[3] SG	2.9	0.02	0.05	0.8	No unit
C	[4] Combustion/LECO	0.1	0.005	0.01	3	%
S	Combustion/LECO	0.08	*	*	*	%
S	[5] 4A_MICP	0.1	0.01	0.02	9	%
LOI	[6] LOI	1.5	0.03	0.06	2	%
Ag	4A_MICP	0.06	0.005	0.01	9	ppm
Al	4A_MICP	85157	569	1137	0.7	ppm
As	4A_MICP	7	0.3	0.6	4	ppm
Ba	4A_MICP	193	2	4	0.9	ppm
Be	4A_MICP	0.5	0.01	0.03	3	ppm
Bi	4A_MICP	0.1	0.01	0.02	9	ppm
Ca	4A_MICP	72843	485	970	0.7	ppm
Cd	4A_MICP	0.1	0.02	0.04	16	ppm
Ce	4A_MICP	22	0.3	0.5	1	ppm
Co	4A_MICP	44	0.4	0.7	0.8	ppm
Cr	4A_MICP	300	21	42	7	ppm
Cs	4A_MICP	1	0.02	0.04	1	ppm
Cu	4A_MICP	116	2	3	1	ppm
Fe	4A_MICP	7.5	0.05	0.1	0.7	%
Ga	4A_MICP	19	0.3	0.5	1	ppm
Ge	4A_MICP	1	0.05	0.1	5	ppm
Hf	4A_MICP	2	0.05	0.1	2	ppm
In	4A_MICP	0.05	0.005	0.01	9	ppm
K	4A_MICP	4949	61	122	1	ppm
La	4A_MICP	11	0.1	0.2	1	ppm
Li	4A_MICP	12	0.2	0.4	1	ppm
Mg	4A_MICP	36407	346	692	1	ppm
Mn	4A_MICP	1202	9	19	0.8	ppm
Mo	4A_MICP	0.8	0.08	0.2	9	ppm
Na	4A_MICP	18131	190	379	1	ppm
Nb	4A_MICP	7	0.08	0.2	1	ppm
Ni	4A_MICP	97	0.7	1	0.7	ppm

Table 3. Recommended concentrations, Standard Deviation, Two Standard deviations, and Relative Standard Deviation.

Analyte	Method	[7]Mean	[8]Standard Deviation (s) ±	[9]Two Standard Deviation (2s) ±	[10]%RSD	Unit
P	4A_MICP	879	15	29	2	ppm
Pb	4A_MICP	4	0.2	0.3	4	ppm
Rb	4A_MICP	15	0.2	0.4	2	ppm
Re	4A_MICP	<0.002	**	**	**	ppm
Sb	4A_MICP	0.3	0.02	0.03	6	ppm
Sc	4A_MICP	28	0.5	0.9	2	ppm
Se	4A_MICP	<0.5	**	**	**	ppm
Sn	4A_MICP	0.8	0.3	0.6	37	ppm
Sr	4A_MICP	332	2	4	0.6	ppm
Ta	4A_MICP	0.4	0.005	0.01	1	ppm
Te	4A_MICP	<0.2	**	**	**	ppm
Th	4A_MICP	1	0.02	0.04	2	ppm
Ti	4A_MICP	5467	56	112	1	ppm
Tl	4A_MICP	0.1	0.008	0.02	6	ppm
U	4A_MICP	0.4	0.01	0.02	3	ppm
V	4A_MICP	198	3	5	1	ppm
W	4A_MICP	0.3	*	*	*	ppm
Y	4A_MICP	23	0.2	0.3	0.7	ppm

1. *XRF is X-ray Fluorescence.*
2. *NiS is Nickel Sulphide with either ICPOES/ICPMS/AAS finish.*
3. *SG is Specific Gravity.*
4. *Combustion/LECO.*
5. *4A_MICP is a Four-acid digestion with either ICPOES/ICPMS/AAS finish.*
6. *LOI is Loss On Ignition.*
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 results were too similar and s, 2s and %RSD could not be calculated.*
12. *** denotes that the element/oxide was not detected and s, 2s and %RSD could not be calculated.*

2. Intended Use

AMIS0926 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 volcanic basalt rock dust and the material was sourced in South Africa.

5. Approximate Mineral and Chemical Composition

This material has a composition of 51.0 wt% SiO_2, 0.8 wt% TiO_2, 9.29 wt% FeO and 18.0 wt% Al_2O_3.

6. Health and Safety

The material is a very fine pale 10YR 6/4 Pale Yellowish Brown powder. Safety precautions for handling fine particulate matter are recommended, such as the use of safety glasses, breathing protection, gloves and a laboratory coat.

7. Method of Preparation

The material was dried. It was then blended in a bi-conical mixer, 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.

8. Particle Size Determination

The sample has been analysed using sieve analysis on a wet sample. The particles are passed through multiple sieves of different sizes. The results for this standard are presented in Table 3.

Table 4. Particle Size Determination.

Size (µm)	Vol. Under %
<38µm	66.76
<53µm	75.86
<63µm	88.27
<75µm	93.89
<90µm	97.71
<106µm	98.88
<150µm	99.68

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9. 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.

Sample preparation for X-Ray Diffraction

The material submitted was prepared for XRD analysis using a backloading preparation method.
It was analysed with a PANalytical Aeris diffractometer with PIXcel detector and fixed slits with Fe filtered Co-Kα radiation. The phases were identified using X'Pert Highscore plus software and PAN-ICSD and ICDD PDF4 2016 databases. The relative phase amounts (weight %) were estimated using the Rietveld method. The amorphous phases such as glass do not produce a pattern and are excluded

in the quantification, but the amount of amorphous component could be quantified by an internal or external standard method.

Comment

- Mineral names may not reflect the actual compositions of minerals identified, but rather the mineral group.
- Due to preferred orientation and crystallite size effects, results may not be as accurate as shown.
- Smectite, lizardite (serpentine), vermiculite, chlorite and kaolinite peaks overlap and further test would be necessary to distinguish. Identification is largely based on peak shapes and positions.
- Traces of additional phases may be present. Quantities below 0.5% may be unreliable.
- Amorphous phases, if present, were not taken into consideration during quantification.

Table 5. Results of XRD analysis.

Mineral	Unit	Composite
Quartz	wt%	2.3
Plagioclase	wt%	59
Augite	wt%	10
Enstatite	wt%	6.5
Kaolinite	wt%	1.7
Muscovite	wt%	11.4
Talc	wt%	0.8
Calcite	wt%	1.8
Hematite	wt%	0.3
Chlorite	wt%	1.3
Smectite	wt%	4.9
Total		100%

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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.
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 30g 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 000: 05 February 2024

Version: 000

Approving Officer:

African Mineral Standards: ____

Melesha Gopi Mungaroo (Senior Quality Specialist)

End of Report