Certificate of Analysis

IAG / CGL 019
MTA-1 (Trachyandesite)

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Description of the certified reference material

The starting material, a bulk of trachyandesite was collected from the trachyte-latite occurrence at Durvun dert, located in the territory of Mandal-Ovoo soum, Umnugobi province, Mongolia. Sampling was performed by the Central Geological Laboratory (CGL), Ulaanbaatar, Mongolia in accordance with relevant sampling procedures in 2010. Mineralogical composition of the sample has been determined as follows:

Minerals	*g/100 g*
Plagioclase	*55*
Potassium feldspar	*15*
Hornblende	*10*
Biotite	*5*
Hematite	*5*
Clinopyroxene	*3*
Pseudomorphs of chlorite and carbonate	*3*
Titanite	*3*
Apatite	*1*

Sample preparation, homogeneity and stability testing studies were performed by the CGL laboratories between 2010 and 2014. After crushing and pulverization, the entire batch of selected bulk material passed a sieve with an opening of 75 µm using an ultrasonic sieving machine. The pulverized bulk material was homogenized using a high performance intensive mixer. After the primary homogeneity testing study, portions of 100 g and 250 g were bottled using a rotary splitter and labelled. After homogenization and bottling, a homogeneity testing study was performed under repeatability conditions. Thirty-two measurands were determined in duplicate on 10 randomly selected units. Homogeneity test results were evaluated using the F-test and against ISO 13528 and the "harmonized protocol" and confirmed that material is sufficiently homogeneous.

Intended use

This certified reference material is designed for use by laboratories undertaking the determination of major and trace element mass fractions in silicate rocks and equivalent matrices for the calibration of a measurement system, the assessment of a measurement procedure, assigning values to other materials, and quality control. Note that the material may be used only for a single purpose in the same measurement process. For example, it must not be used for calibration and method validation at the same time.

Instructions for handling

When non-volatile analytes are to be determined, test portions of the test sample must be dried at 105 ± 5 °C for at least 2 hours. Avoid contamination and cross-contamination of the test material during handling. The material should not be reground before use. The mass loss on drying has been found to be in the range 0.28-0.82 g/100 g.

Minimum sample size

The minimum size of test portion is recommended to be 0.2 g, based on the results of a formal repeatability assessment procedure undertaken by the Central Geological Laboratories, Mongolia.

Storage information

Store in a sealed container in a cool dry environment.

Period of validity

Provided the storage and handling conditions are met, this reference material is not expected to deteriorate with time. As a consequence, the nominal period of validity of this certificate is selected as 20 years. On exposure to air, the material may absorb moisture, and instructions for handling to remove absorbed water before use of the material must be followed.

Certified values

This material was certified based on procedures that are summarised in the International Association of Geoanalysts' Certification Protocol (Kane et al., 2003, Geostandards and Geoanalytical Research, 27, 227-244). Twenty-five laboratories (listed in ***Appendix 1****) were invited to participate in this certification round on the basis of their successful performance in round 27 of the IAG GeoPT proficiency testing programme (2010). A nested design was adopted for data acquisition as proposed in the IAG certification protocol. Participating laboratories received 3 bottles of MTA-1 and one bottle of CGL 009 MGL-AND (the "traceability" sample which was used here for quality control purposes). Participating laboratories were requested to make two independent sample preparations (e.g., digestions) of each bottle and analyse the preparations on two different days. Laboratories were thus requested to submit 12 values (3x2x2 Bottles x Prep x Day) for each measurand for which they had the analytical capability. Values for Cs, LOI, Lu, Ta, Th, Tm and U were certified on the basis of results from a single technique.*
Further details of the quality of data and data distributions may be found in the associated IAG/CGL 019 MTA-1 certification report.

Number of values, 'p'

*The number of technically valid data sets (**p**) that contributed to the estimation of the certified value after rejection of outliers is listed in the tables. Outliers were selected based in Youden plots, Mandel's k and detection limit criteria.*

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Certified values and uncertainties

Measurand	Certified value	Uncertainty (expanded)	Unit	p		Measurand	Certified value	Uncertainty (expanded)	Unit	p
SiO_2	58.64	0.20	*g/100 g*	17		**La**	112	4	*mg/kg*	19
TiO_2	1.395	0.009	*g/100 g*	21		**Li**	22.7	1.2	*mg/kg*	12
Al_2O_3	16.0	0.7	*g/100 g*	21		**Lu**	0.179	0.005	*mg/kg*	15
Fe_2O_3T	5.91	0.04	*g/100 g*	22		**Nb**	14.8	0.8	*mg/kg*	22
MnO	0.0469	0.0010	*g/100 g*	22		**Nd**	90.7	2.9	*mg/kg*	16
MgO	1.74	0.03	*g/100 g*	21		**Ni**	27.0	1.3	*mg/kg*	21
CaO	3.85	0.03	*g/100 g*	22		**Pb**	34.1	1.2	*mg/kg*	22
Na_2O	4.41	0.04	*g/100 g*	19		**Pr**	25.3	0.7	*mg/kg*	15
K_2O	4.85	0.04	*g/100 g*	20		**Rb**	104	3	*mg/kg*	21
P_2O_5	1.002	0.007	*g/100 g*	22		**Sb**	8.5	1.1	*mg/kg*	11
						Sc	8.6	0.7	*mg/kg*	15
As	6.5	0.8	*mg/kg*	11		**Sm**	13.2	0.3	*mg/kg*	15
Ba	2828	53	*mg/kg*	24		**Sn**	1.8	0.4	*mg/kg*	10
Be	2.22	0.11	*mg/kg*	10		**Sr**	2692	50	*mg/kg*	26
Ce	219	7	*mg/kg*	17		**Ta**	0.74	0.05	*mg/kg*	11
Co	13.4	0.4	*mg/kg*	20		**Tb**	0.871	0.019	*mg/kg*	15
Cr	35	2	*mg/kg*	18		**Th**	11.4	0.4	*mg/kg*	17
Cs	11.7	0.5	*mg/kg*	13		**Tm**	0.207	0.006	*mg/kg*	15
Cu	21.6	1.1	*mg/kg*	21		**U**	1.72	0.15	*mg/kg*	15
Dy	4.03	0.13	*mg/kg*	14		**V**	102	3	*mg/kg*	23
Er	1.62	0.05	*mg/kg*	12		**Y**	17.7	0.7	*mg/kg*	23
Eu	3.36	0.10	*mg/kg*	13		**Yb**	1.231	0.021	*mg/kg*	15
Ga	21.7	0.6	*mg/kg*	18		**Zn**	89	3	*mg/kg*	22
Hf	8.3	0.4	*mg/kg*	15		**Zr**	368	12	*mg/kg*	23
Ho	0.658	0.012	*mg/kg*	15						

Certified value *and* ***uncertainty:*** *see text*
p: *number of technically valid data sets (after outlier rejection) that contributed to the certified value*
Fe_2O_3T is the total iron expressed as Fe_2O_3.

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Information values and uncertainties

Measurand	Information value	Uncertainty (expanded)	Unit	p
Bi	0.10	0.02	*mg/kg*	7
Gd	7.8	0.5	*mg/kg*	14
H_2OM	0.58	0.14	*g/100 g*	8
LOI	1.33	0.11	*g/100 g*	19
Mo	1.74	0.10	*mg/kg*	9
Tl	0.45	0.03	*mg/kg*	8
W	0.93	0.14	*mg/kg*	8

Information value *and* ***uncertainty*** *– see text.*
p: *number of technically valid data sets (after outlier rejection) that contributed to the information value.*
H_2OM is the moisture (weight loss on drying at 105 °C for 2 hours).
LOI is the mass loss on ignition (generally 1050 °C for 2 hours).

Uncertainties

U is the expanded uncertainty, corresponding to 95% confidence limits and incorporates the relevant Student's t factor (t) to account for the finite number of contributing laboratory average measurements. The standard uncertainty (u) may be calculated from u = U/t and includes a random component, and a material variability (heterogeneity) component, as described in Kane et al. (2003). The stability component has not been included, as it is vanishingly small compared to the other components.

Information values

Information values are designed to provide guidance on the mass fractions of other selected elements and should not be used to validate analytical measurements. A minimum of 5 laboratory average determinations were used to calculate information values.

Metrological traceability

Traceability was demonstrated for this reference material by requesting participating laboratories to co-analyse the certified reference material MGL-AND (andesite). This material was certified by the Central Geological Laboratory, Mongolia (B. Batjargal and Z. Ganbold, 2009, Certificate of Analysis CGL 009 MGL-AND, Central Geological Laboratory, Ulaanbaatar, Mongolia, 6pp). An assessment of the results for CGL 009 MGL-AND was undertaken to confirm the absence of systematic bias, thus establishing a chain of comparisons between the present IAG/CGL 019 MTA-1 certification and a previous geochemical certification project.

Certification characterisation report

Further details of the procedures used, the results, their statistical analysis and data assessment, on which the property values listed in this certificate are based, can be found in the IAG/CGL 019 MTA-1 report.

Safety information

Silicate powders can cause harm especially if ingested or in contact with the skin. User organisations must undertake a health and safety risk assessment and ensure that the appropriate procedures are followed in the handling and use of this material. Further details may be found on the relevant material safety data sheet.

Legal notice – terms and conditions

1. The IAG shall not be liable to the user of this material for loss (whether direct or indirect) of profits, business, anticipated savings or reputation or for any indirect or consequential loss or damage whatsoever even if previously advised thereof and whether arising from negligence, breach of these Terms and Conditions or howsoever occurring.
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Revisions

This certificate is version 1.10, issued on 10th March 2016. Any further revisions to this Certificate of Analysis will be made available on the IAGeo Ltd web site (www.iageo.com).

Acknowledgements

Members of the IAG Certification and Reference Material Committee are gratefully acknowledged for their contributions to this certificate, but especially the Management and CRM teams of the Central Geological Laboratory, Ulaanbaatar who are gratefully acknowledged for preparing and supplying this material. The IAG is very grateful to Mrs B. Davaasuren for coordinating the production of this certificate. We are very grateful to the laboratories listed in Appendix 1 for providing data for this certification programme.

Approvals

This Certificate of Analysis was approved on behalf of the International Association of Geoanalysts and the Central Geological Laboratories, Mongolia as follows:

Name *Phil Potts* **Position** *Chair of the IAG Certification and Reference Material Committee* **Date 16th November 2015**

Name *Thomas Meisel* **Position** *President of the International Association of Geoanalysts.* **Date 18th November 2015**

Name *Tegshbayar Norov* **Position** *Director of the Central Geological Laboratory, Ulaanbaatar, Mongolia* **Date 17th November 2015**

Appendix 1

Laboratories that participated in this MTA-1 certification programme.

- *All-Russia Geological Research Institute, St. Peterburg, Russia*
- *ALS Minerals, North Vancouver, Canada*
- *Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover, Germany*
- *Central Geological Laboratory, Ulaanbaatar, Mongolia*
- *Centro Technologico da Ceramica e do Vidro, Coimbra, Portugal*
- *CERAM Testing & Environmental services, Staffordshire, United Kingdom*
- *Forschungsinstitut fuer Anorganische Werkstoffe-Glas/Keramik GmbH, Germany*
- *Geological Survey of Denmark and Greenland (GEUS), Copenhagen, Denmark*
- *Institute of Geology Tallinn University of Technology, Tallinn, Estonia*
- *Instituto de Geociencias, Universidade Estadual de Campinas, Campinas- Sao Paulo, Brazil*
- *Instituto de Geociencias-USP, Sao Paulo, Brazil*
- *Instituto Geologico y Minero de Espana, Cantos-Madrid, Spain*
- *Laboratorio Nacional de Energia e Geologia, Portugal*
- *Laboratory of Chemical and Analytical Researches Sergey Lyapunov, Moscow, Russia*
- *LAPP Insulators GmbH, Wunsiedel, Germany*
- *Memorial University of Newfoundland, Canada*
- *Mineralogisch-Geochemisches Institut, Freiburg i.Br, Germany*
- *Montanuniversiät Leoben, Leoben, Austria*
- *Saint-Gobain Research Co., Ltd, Shanghai, China*
- *Savannah River National Laboratory, Aiken, SC, USA*
- *Service d'Analyse des Roches et Minéraux, Vandoeuvre, France*
- *SGS Minerals Services, Ontario, Canada*
- *Siebersdorf Labor GmbH, Austria*
- *State Geological Institute of Dionyz Stur, Markusovska, Slovakia*
- *X-ray Analytics and Consulting, Frankfurt am Main, Germany*

Revision Schedule

1.01 (21st December 2015) – Spelling correction - *Durvun dert not Durvun durt*

1.20 (10th March 2016) – Addition of Appendix 1 (participating laboratories) and associated revisions to the text.