



MONGOLIA
CENTRAL GEOLOGICAL LABORATORY



CERTIFICATE OF ANALYSIS

CERTIFIED REFERENCE MATERIAL GREISEN "MGn"

Certified values

№	Oxide/element	Units	CV ¹	U ²	N ³
1	SiO ₂	% m/m	80.93	0.40	18
2	TiO ₂	% m/m	0.086	0.003	14
3	Al ₂ O ₃	% m/m	10.26	0.66	18
4	T Fe ₂ O ₃	% m/m	3.25	0.09	18
5	MnO	% m/m	0.102	0.004	17
6	MgO	% m/m	0.044	0.009	11
7	CaO	% m/m	0.836	0.032	17
8	K ₂ O	% m/m	1.47	0.16	14
9	P ₂ O ₅	% m/m	0.018	0.002	10
10	LOI*	% m/m	1.46	0.05	12
11	As	mg/kg	63.6	3.3	12
12	Cr	mg/kg	271	17	15
13	Cu	mg/kg	563	24	14
14	Ga	mg/kg	26.1	1.9	11
15	Nb	mg/kg	28.4	2.8	12
16	Rb	mg/kg	463	57	12
17	Sn	mg/kg	1884	76	12
18	Sr	mg/kg	16.6	3.2	11
19	Th	mg/kg	32.9	4.4	11
20	Y	mg/kg	94.6	17.7	13
21	Zn	mg/kg	273	11	15
22	Zr	mg/kg	148	6	11

¹ Certified value (CV) – based on a minimum of 10 results with a minimum of 2 independent methods

² Estimated expanded uncertainty (U) - with a coverage factor k=2, corresponding to a level of confidence of about 95 %, as defined in ISO/IEC GUIDE 98-3:2008 "Uncertainty of measurement - Part 3: Guide to the Expression of Uncertainty in Measurement (GUM:1995)"

³ Number of datasets (N)

* LOI – Loss on Ignition

Additional Information

№	Oxide/element	Units	IV ⁴	N ³
1	Na ₂ O	% m/m	0.038	10
2	F	% m/m	1.48	7
3	Ba	mg/kg	25.6	10
4	Be	mg/kg	2.94	3
5	Bi	mg/kg	29.6	8
6	Ce	mg/kg	107	8
7	Co	mg/kg	3.19	4
8	Cs	mg/kg	29.7	8
9	Dy	mg/kg	14.1	3
10	Er	mg/kg	10.6	3
11	Gd	mg/kg	10.7	3
12	Hf	mg/kg	7.15	3
13	Ho	mg/kg	3.19	3
14	La	mg/kg	43.0	8
15	Lu	mg/kg	1.72	3
16	Nd	mg/kg	41.3	6
17	Pb	mg/kg	11.2	7
18	Pr	mg/kg	12.8	3
19	Sm	mg/kg	11.0	4
20	Ta	mg/kg	4.01	3
21	Tb	mg/kg	2.13	3
22	Tm	mg/kg	1.72	3
23	U	mg/kg	6.12	7
24	V	mg/kg	6.37	3
25	W	mg/kg	45.0	11
26	Yb	mg/kg	12.1	3

⁴ Non-certified “information value” (IV) – one certification criteria is not fulfilled

Intended uses of this Certified Reference Material (CRM)

Based on defined metrological characteristics-metrological traceability of assigned property values and associated measurement uncertainties also physical characteristics – homogeneity and small particle size, this CRM is suitable for method development, calibration, validation and quality assurance, quality control purposes when analyzing samples that are matrix- matched to this material.

Description of sample

The starting material, a bulk of greisen with a total mass of 165 kg was collected by Central Geological Laboratory (CGL) from occurrence of Baga gazryn chuluu of Delgertsogt soum, Dundgobi province, Mongolia.

Based on mineralogical and petrographical investigation at CGL laboratories, the mineral composition of the material has been determined to be:

Minerals	Percentage %, m/m
Quartz	73.1
Sericite - muscovite	17.5
Andalusite	8.5
Fluorite	0.65
Cassiterite	0.25
Sphen	few
Apatite	few
Goethite	few
Jarosite	few

Sample preparation

The preparation, homogeneity and stability testing were performed by the CGL laboratories in 2008 – 2013.

After crushing and pulverization, the entire batch of selected bulk material passed a sieve with an opening of 0.075 mm of an ultrasonic sieving machine.

The pulverized bulk material was homogenized by a high performance intensive mixer.

After testing the homogeneity, portions of 100 g and 250 g reference material each were bottled by rotary splitting from this batch to polyethylene bottles and labeled.

Homogeneity of material

Within and between bottles homogeneity testing was performed under repeatability condition, using 10 samples randomly selected. Homogeneity test result confirmed that material is sufficiently homogeneous.

Certification

An interlaboratory approach with 11 participating laboratories was selected to obtain a reliable base of data for assignment of the certified values. A nested design was chosen for maximum information output.

The traceability was established to the existing CRM – Greisen GnA produced at Central Geological Institute of German Democratic Republic (by former name).

Production and evaluation procedures for compliance with the valid ISO Guides were assessed and certified by the Technical Committee of CGL.

Instructions for Storage and Use

The CRM should be stored at room temperature and tightly sealed to protect it from absorption of atmospheric moisture, direct sun reflection and laboratory chemicals. The material can be transported by any kind of transport means.

To overcome segregation effect due to storage or transportation, the material should be shaken appropriately before opening the bottle.

No material that had once been removed from the original sample bottle should be returned to it, as that might cause contamination of the remaining sample.

Certified values and information values are reported on a dry weight basis (105°C, 2 h).

The recommended minimum sample test portion mass is 100 mg. If a test method requires a test to portion less than 100 mg, it is recommended that an excess of the CRM (> 100 mg) is further pulverized in an agate mortar, before weighing out the needed mass.

Validity of the Certificate

This material is considered to be stable. The stability of the material will be monitored regularly for the duration of the inventory. Therefore, this certificate of analysis shall remain valid through 2023, unless users are otherwise notified.

Availability of Material

This certified reference material will be classified as **CGL 022** in accordance with CGL CRM classification system. It is available from:

Central Geological Laboratory
CGL-building
Trade Union Street
Songinokhairkhan District
P.O.Box -437
18080 Ulaanbaatar
MONGOLIA

Tel.: +/ 976 11/ 632904, 632914
Fax: +/ 976 11/ 632944, 632564
E-mail: info@cegeolab.com
cegeolab@mbox.mn
Web: www.cegeolab.com

Customer Feedback

Customers, using this CRM are kindly requested to register at the Central Geological Laboratory. This opens the opportunity to notify the user community on any new development with regard to this CRM. Customer feedback with respect to any information included in this certificate is highly appreciated.

Test methods applied for this certification

Al ₂ O ₃	ED/WD XRF (9), ICP-MS (1), ICP-OES/AES (1), AAS (1), SPEC (2), TITR (4)	Na ₂ O	ED/WD XRF (4), ICP-MS (1), ICP-OES/AES (1), AAS (4)
As	ED/WD XRF (6), ICP-MS (1), ICP-OES/AES (4), AAS (1)	Nb	ED/WD XRF (8), ICP-MS (2), ICP-OES/AES (1), OTHER (1)
Ba	ED/WD XRF (6), ICP-MS (2), ICP-OES/AES (2)	Nd	ED/WD XRF (2), ICP-MS (3), ICP-OES/AES (1)
Be	ICP-MS (2), AAS (1)	Ni	ICP-MS (1), ICP-OES/AES (1), AAS (1)
Bi	ED/WD XRF (5), ICP-OES/AES (1), AAS (2)	P ₂ O ₅	ED/WD XRF (9), AAS (1)
CaO	ED/WD XRF (11), ICP-OES/AES (1), TITR (5)	Pb	ED/WD XRF (3), ICP-MS (2), ICP-OES/AES (1), AAS (1)
Ce	ED/WD XRF (5), ICP-MS (3)	Pr	ICP-MS (3)
Co	ED/WD XRF (1), ICP-MS (2), AAS (1)	Rb	ED/WD XRF (7), ICP-MS (3), AAS (1), OTHER (1)
Cr	ED/WD XRF (7), ICP-MS (2), ICP-OES/AES (5), AAS (1)	SiO ₂	ED/WD XRF (10), ICP-OES/AES (1), SPEC (4), GRAV (3)

Cs	ED/WD XRF (4), ICP-MS (3), AAS (1)	Sm	ED/WD XRF (1), ICP-MS (3)
Cu	ED/WD XRF (6), ICP-MS (1), ICP- OES/AES (5), AAS (2)	Sn	ED/WD XRF (7), ICP-MS (3), AAS (1), TITR (1)
Dy	ICP-MS (3)	Sr	ED/WD XRF (6), ICP-MS (2), ICP- OES/AES (3)
Er	ICP-MS (3)	Ta	ICP-MS (3)
Eu	ICP-MS (2)	Tb	ICP-MS (3)
F	ED/WD XRF (4), SPEC (3)	T Fe ₂ O ₃	ED/WD XRF (12), ICP-MS (1), ICP- OES/AES (1), SPEC (2), TITR (2)
Ga	ED/WD XRF (7), ICP-MS (3), ICP- OES/AES (1)	Th	ED/WD XRF (7), ICP-MS (3), ICP- OES/AES (1)
Gd	ICP-MS (3)	TiO ₂	ED/WD XRF (9), ICP-MS (1), ICP- OES/AES (1), SPEC (3)
Hf	ED/WD XRF (1), ICP-MS (2)	Tm	ICP-MS (3)
Ho	ICP-MS (3)	U	ED/WD XRF (4), ICP-MS (3)
K ₂ O	ED/WD XRF (10), ICP-MS (1), ICP- OES/AES (1), AAS (2)	V	ED/WD XRF (1), ICP-MS (1), AAS (1)
La	ED/WD XRF (4), ICP-MS (3), ICP- OES/AES (1),	W	ED/WD XRF (7), ICP-MS (2), ICP-OES/AES (2)
LOI	GRAV (12)	Y	ED/WD XRF (6), ICP-MS (2), ICP-OES/AES (4), OTHER (1)
Lu	ICP-MS (3)	Yb	ICP-MS (3)
MgO	ED/WD XRF (9), ICP-MS (1), ICP-OES (1)	Zn	ED/WD XRF (6), ICP-MS (1), ICP-OES/AES (7), AAS (1)
MnO	ED/WD XRF (11), ICP-MS (1), ICP- OES/AES (1), AAS (4)	Zr	ED/WD XRF (7), ICP-MS (1), ICP-OES/AES (1), AAS (1), OTHER (1)

Abbreviations

- ED/WDXRF - energy/wavelength dispersive x-ray fluorescence spectrometry
- ICP- MS - inductively coupled plasma - mass spectrometry
- ICP-OES/AES - inductively coupled plasma-optic/atomic emission spectrometry
- AAS - atomic absorption spectrometry
- SPEC - spectrophotometry
- TITR - titrimetry
- GRAV - gravimetry
- OTHER - other method

Participating Laboratories

1. All Russia Geological Research Institute, Petersburg, Russia
2. BGR-Federal Institute for Geosciences and Natural Resources, Hannover, Germany
3. Center for Mineral Technology, Rio de Janeiro, Brazil
4. Central Geological laboratory (Reference Material and Metrology section, Laboratory of Chemical & Physical Techniques, Laboratory of Radioactive Material), Ulaanbaatar, Mongolia
5. Eurotest Control JSC, Bulgaria

6. Geological survey of Israel, Israel
7. Geoscience Laboratories, Ontario, Canada
8. Institute de Technologia Ceramica, Chemical Analysis Unit, Castellan, Spain
9. Institute of Geochemistry SB Ras, Irkutsk, Russia
10. Institute of Mineralogy, Geochemistry and Crystal-chemistry for Rare Elements, Moscow, Russia
11. The Southern and Eastern African Mineral Centre, Tanzania

Legal notice

Based on the decision of Technical Committee of Central Geological Laboratory of 31 October 2013, by the resolution No 206 of director of CGL, this material had been approved as a Certified Reference Material with a code number CGL 022.