

**VINOGRADOV INSTITUTE OF GEOCHEMISTRY
SIBERIAN BRANCH OF RUSSIAN ACADEMY OF SCIENCES**

CATALOGUE

**OF CERTIFIED REFERENCE MATERIALS
OF NATURAL AND MAN-MADE MEDIA COMPOSITIONS**



Irkutsk – 2017

Catalogue of Certified Reference Materials of Natural and Man-made Media Compositions

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LIST OF CERTIFIED REFERENCE MATERIALS

Name of CRM	Acronym, № GSO	Number of component	
		Certified	Informed
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Dunite	SDU-1 (GSO 4233-88)	20	6
Trap	ST-2a (GSO 8671-2005)	47	11
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Limestone Dolomitized	SI-2 (GSO 3193-85)	24	11
Feldspar-bearing Dolomite	SI-3 (GSO 3192-85)	23	9
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Black Shale (Ore of Suhoi Log)	SLg-1 (GSO 8550-2004)	43	21
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RECENT LOOSE SEDIMENTS			
Baikal Bottom Silt	BIL-1 (GSO 7126-94)	49	17
Baikal Bottom Sediment	BIL-2 (GSO 7176-95)	30	18
Carbonate Background Silt	SGH-1 (GSO 3131-85)	32	8
Terrigenous Background Silt	SGH-3 (GSO 3132-85)	35	6
Anomalous Silt	SGH-5 (GSO 3133-85)	36	5
Carbonate-silicate Loose Sediments	SGHM-1 (GSO 3483-86)	31	9
Alumosilicate Loose Sediments	SGHM-2 (GSO 3484-86)	30	10
Carbonate-silicate Loose Sediments	SGHM-3 (GSO 3485-86)	32	9
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Gold-bearing Ore	SZR-3 (GSO 8815-2006)	5	-
Gold-bearing Ore	SZR-4 (GSO 8816-2006)	5	-
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Coal Ash of Azey	ZUA-1 (GSO 7177-95)	31	17
Coal Fly Ash	ZUK-2 (GSO 9237-2008)	38	20
Concentrate of Magnetic Cenospheres	KMC-1 (GSO 9234-2008)	37	16
Concentrate of Magnetic Cenospheres	KMC-2 (GSO 9235-2008)	39	20
Concentrate of Magnetic Microspheres	KMM-1 (GSO 9236-2008)	27	26
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Mixture of Meadowherbs	Tr-1 (GSO 8922-2007)	38	25
Canadian Pondweed	EK-1 (GSO 8921-2007)	34	30
Baikal Perch Musculus Tissue	BOk-2 (GSO 9055-2008)	17	9

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INTRODUCTION

Vinogradov Institute of Geochemistry SB RAS for more than 40 years is developing certified reference materials (CRMs) of natural and man-made environments. In IGC SB RAS fruitful development of science way – Metrology of chemical analysis of substances – connected with the names of well-known spectroscopist-analysts Doctors of Sciences Ya.D. Raikhbaum, S.V. Lontsikh, L.L. Petrov and I.E. Vasil'eva.



Ya.D. Raikhbaum



S.V. Lontsikh



L.L. Petrov



I.E. Vasil'eva

CRM is a fine powder, prepared by grinding solid material of various composition and genesis, in which the mass fractions of major and trace elements and components are certified. The created collection of multi-element samples of natural and man-made environments consists of certified referent materials and referent materials; is regularly replenished by new samples of various composition and genesis; and is focused on ensuring the uniformity of measurements in geoanalysis. CRM collection is used to certify measurement techniques applied in determining the composition of natural and man-made objects; accuracy control (precision and trueness) of the results of chemical, physical and physicochemical methods of laboratory analysis of substances and materials, as well as professional testing of laboratories.

Nomenclature of the collection from Vinogradov Institute of Geochemistry SB RAS is composed of certified reference materials of natural and man-made environments. The natural cluster of the collection is represented by igneous, metamorphic and sedimentary rocks, sediments, biological substances of plant and animal origin. The composition of igneous rocks varies from acidic to ultrabasic. Modern sedimentary rocks are represented by sediments of the Lake Baikal, terrigenous river silt and continental loose sediments. Four samples of the biota include terrestrial and aquatic plants, also Baikal perch tissue. Man-made environments of the collection are presented by gold-bearing ores and products of their processing (concentrates, tails of flotation and gravitation), as well as ash of energy coals of various composition and fractions extracted from it.

The certified values correspond to requirements of the following documents: GOST 8.010-2013, GOST ISO Guide 35:2015, GOST R ISO 5725-2-2002, GOST R ISO 5725-6-2002, RMG 61-2010, OST MPR&E RF 41-08-212-2010, GOST 8.532-2002 and GOST 8.315-97 for the certification of the sample as CRM and RM.

Measurement methods of the determination of certified values and their traceability were used:

AAS – Atomic-absorption spectrometry;

AES – Atomic-emission spectrometry;

AES-ICP – Atomic-emission spectrometry with inductively coupled plasma;

FAES – Flame atomic emission spectrometry;

Electrochemical methods such as: AT – Amperometric titration; POL / ISE – Polarography, Ion selective electrode; PT – Potentiometric titration;

G – Gravimetry;

MS-ICP – Mass-spectrometry with inductively coupled plasma;

NAA – Neutron activation analysis;

SPh – Spectrophotometry;

T – Titrimetry;

XFS – X-ray fluorescence spectrometry;

TOC – total organic C-H-N-S analysis fulfilled by combustion of the sample in an oxygen atmosphere in quartz tube and using by C-H-N-S analyzers;

and also other methods and techniques with preliminary extraction and sorption of trace elements.

CRMs may be transported by any means of transport provided the air-tightness of package is ensured. After opening the certified reference material should be stored in an airtight container, protected from exposure to chemicals and moisture, at the temperature (20-25) °C and relative humidity less than 80 %.

Some CRMs from the collection were created more than 30 years ago. The contents of elements and components in them are certified according to interlaboratory tests, by analytical methods the most widely used at that time. The development of physical and chemical methods of analysis had been improved accuracy of the results, but the requirements for the metrological characteristics and for the minimum representative mass of CRM have become more stringent (e.g. nowadays analytical methods use analytical weights ≤ 0.1 g). The regular testing of the collection resulted to confirm the homogeneity and stability of the substances of CRMs, and provide the shelflife of these samples up to 40-45 years.

The CRM certified values and their errors (uncertainties) were established by inter-laboratory experiment with participation of qualified laboratories, experienced in the research of substances that are similar in composition and structure to this CRM, in Russia and other countries: Canada, Germany, Great Britain, France, USA, South Africa, Belgium, Netherlands, China, India, Finland, Poland, Mongolia, Hungary, Belarus, Bulgaria, Cuba, Armenia, Georgia, Kazakhstan, Kyrgyzstan, Lithuania, Slovenia, Syria, Tajikistan, Turkey, Uzbekistan and Ukraine.

The CRM collection is a necessary link in the interdisciplinary investigations of fundamental relationships between different natural objects, in carrying out multidisciplinary environmental studies aimed to assess the state and preservation of the environment and human health.

Vinogradov Institute of Geochemistry SB RAS is a scientific organization that develops CRMs in accordance with the requirements Russian Federal Law “Assurance of the Uniformity of Measurements”, Custom Union and the World Trade Organization.

Information about the CRM collection is available on the following websites:

Vinogradov Institute of Geochemistry SB RAS –

<http://igc.irk.ru/ru/uslugi/eksperimentalnye-obraztsy>

Federal Information Foundation for ensuring the uniformity of measurements –

www.fundmetrology.ru/09_st_obr/list.aspx

The database of COOMET CRMs –

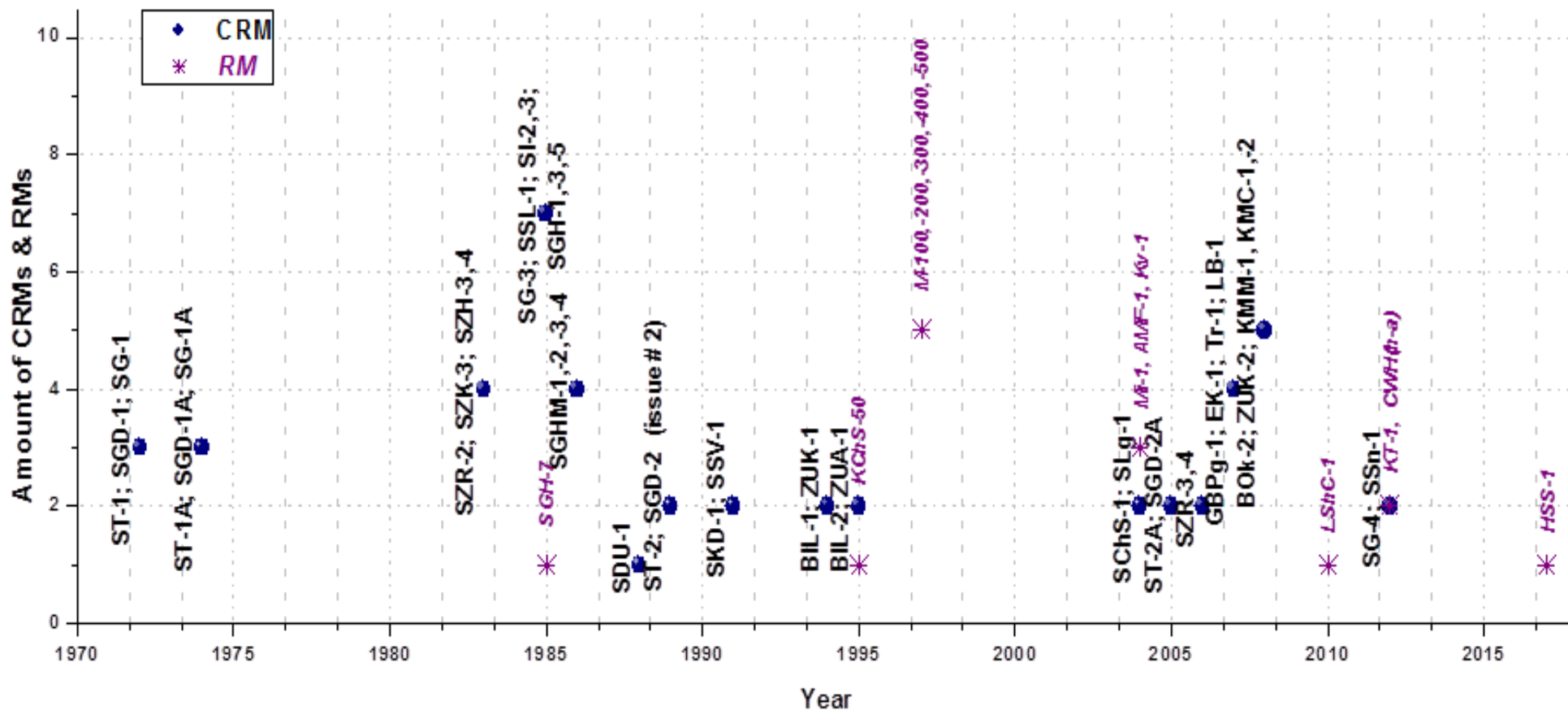
www.coomet.org

COMAR international database for certified reference materials –

www.comar.bam.de

GeoReM database for reference materials of geological and environmental interest – www.georem.mpch-mainz.gwdg.de

Chronology of creating the collection of multielemental reference materials in IGC SB RAS



Certified Reference Material
Dunite
GSO 4233-88 (SDU-1)

Description. The dunite is sampled in the coastal outcrop of Lake Baikal (Sakhjurty Settlement of the Olkhon region, Irkutsk area). This occurrence of dunites is located within the band of ultrabasic rocks of the Olkhon region which belong to the Baikal-Muya basitic-ultrabasic rock belt of the Baikal highland. The ultrabasic massifs consist of small blocks and lenses of ultramafic rocks occurring in highly metamorphic gneiss-carbonate formations of the Lower Proterozoic age. Rocks are dense, fine-grained, dark-colour with a light greenish hue.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for material dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Element	wt %	$\pm\Delta$
SiO ₂	39.58	0.13	Co	0.012	0.001
TiO ₂	0.018	0.002	Cr	0.41	0.01
Al ₂ O ₃	0.97	0.07	Cu	0.0033	0.0004
Fe ₂ O _{3 tot}	8.91	0.07	Ge	0.00011	0.00001
CaO	1.52	0.07	Li	0.00020	0.00003
MgO	41.86	0.28	Ni	0.22	0.01
MnO	0.13	0.01	Sc	0.0009	0.0001
K ₂ O	0.010	0.001	Sr	0.0018	0.0003
Na ₂ O	0.035	0.005	V	0.0033	0.0005
LOI	6.31	0.06	Zn	0.0030	0.0004

Notes:

Fe₂O_{3 tot} – total iron concentration expressed as Fe₂O₃;

LOI – loss on ignition;

wt % – percent of total element/component concentration.

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C)

Component / Element	wt %	Component / Element	wt %
S _{tot}	0.041	H ₂ O ⁺	4.82
FeO	5.54	CO ₂	1.61
H ₂ O ⁻	0.4	P ₂ O ₅	0.01

Table 3. **Mineral composition**

Mineral / phase	vol. %	Mineral / phase	vol. %
Olivine	60.77	Ore minerals (chrom-spinelle,	
Serpentine	19.14	magnetit)	4.89
Amphibole	7.19	Carbonate	0.81
Orthopyroxene	2.42	Chlorite	2.82
Clinopyroxene	1.77	Talk	0.18

Ore minerals include chrome spinelides and magnetites, the former often replaced by magnetite.

Accessory minerals are single grains of sulphides (pyrrhotite, purite, chalcopyrite), limenite, zircon, rutile and apatite.

Table 4. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	+80	-80...+63	-63...+50	-50...+40	-40
Yield of fractions, wt %	0.03	4.92	12.70	13.65	68.70

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Table 5. Representative samples

Element / Component	Analytical weight, g
Ni, Co, Cu, Cr, V, Al, Ti, Mn, Fe _{tot} , Sc, Ge, Zn, Sr, Li, Na, Ca, Mg	0.1
K, P, Si	0.2
FeO	0.4
LOI	0.5

Date of single batch issue: 20.12.1987.

CRM is issued in conformity with Certificate of certified reference material type approval No. **3038**, valid untill.

Certified Reference Material
Trap
GSO 8671-2005 (ST-2A)

Description. The trap is sampled in a quarry from the bedded body about 100 m thick near the town of Tulun, Irkutsk region, from the middle part of sill and consists of common differentiates of trappaeen magma, i.e. dolerites with ophitic structure. Macroscopically, these are dense dark-grey rocks.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	47.99	0.19	MgO	7.51	0.17
TiO ₂	1.59	0.05	MnO	0.21	0.01
Al ₂ O ₃	14.63	0.17	K ₂ O	0.46	0.02
Fe ₂ O _{3 tot}	14.62	0.14	Na ₂ O	2.32	0.09
FeO	10.33	0.14	P ₂ O ₅	0.17	0.01
CaO	10.42	0.14			

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Ba	227	23	Nd	13.2	2.1
Be	0.8	0.1	Ni	126	13
Ce	22	3	Pr	2.6	0.4
Co	52	7	Rb	11	2
Cr	213	11	Sc	41	6
Cu	180	17	Sm	4.0	0.5
Dy	5.1	0.9	Sn	2.64	0.50
Er	2.9	0.5	Sr	197	16
Eu	1.4	0.2	Ta	0.35	0.06
Ga	17	2	Tb	0.8	0.1
Gd	4.5	0.7	Th	1.00	0.15
Ge	1.5	0.2	Tm	0.44	0.08
Hf	2.7	0.5	U	0.45	0.07
La	8	1	V	315	26
Li	8.6	1.2	Y	29	3
Lu	0.44	0.07	Yb	3.3	0.4
Mo	0.98	0.18	Zn	112	11
Nb	6	1	Zr	125	13

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C)

Component / Element	mg/kg	Component / element	mg/kg
Ag	0.05	B	3.8
Au	0.0026	Ho	1
F	210	W	0.4
H ₂ O ⁺	8800	Pb	3
S	260	LOI	4200
Cs	0.45		

Table 3. **Mineral composition**

Mineral / phase	vol.%
Plagioclase	44.58
Monoclinic pyroxene	33.88
Olivine	12.94
Ore minerals (titano-magnetit, ilmenit, magnetit)	3.47
Mesostasis	4.88

Table 4. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %	
	Analizette22	HELOS/BR
+80	0.006	–
-80...+71	0.024	0.02 \pm 0.01
-71...+63	0.04	0.09 \pm 0.04
-63...+50	1.13	1.20 \pm 0.04
-50...+40	3.76	2.78 \pm 0.54
-40	95.04	95.23 \pm 0.22

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Table 5. **Representative samples**

Element / Component	Analytical weight, g
Ba, P, B, Be, Ce, Cs, Cu, La, Nb, Ni, Nd, Hf, Pb, Rb, Sc, Sr, Sm, Ta, Tb, Th, Eu, Lu, Zr, U, Dy, Er	0.05
F, V, Cr	0.075
Mn, Fe _{tot} , FeO, Ti, Mg, Ca, Co, Ge, Ga, Mo, Sn, Zn, As, Sb, W, Ag	0.10
Al, Li	0.15
Si, Na, K, S _{tot}	0.20
LOI	1.0

Date of single batch issue: 20.02.2005.

CRM is issued in conformity with Certificate of certified reference material type approval No. **1196**, valid untill.

**Certified Reference Material
Essexitic Gabbro
GSO 8670-2005 (SGD-2A)**

Description. The essexitic gabbro, a coarse-grained rock gabbro texture partially altered by secondary processes, is sampled from the Dalbyrkey massif, which occurs within the Liljunguy-Urovsky volcanic zone of the Akatuy magmatic complex, East Trans-Baikal area.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	46.63	0.18	MgO	6.81	0.09
TiO ₂	1.72	0.05	MnO	0.167	0.008
Al ₂ O ₃	14.93	0.16	K ₂ O	3.09	0.11
Fe ₂ O _{3 tot}	11.33	0.12	Na ₂ O	2.72	0.07
FeO	6.23	0.13	P ₂ O ₅	1.03	0.02
CaO	10.68	0.14			

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Ba	1520	150	Nb	8.4	1.3
Be	1.9	0.3	Nd	89	11
Ce	163	20	Ni	47	4
Co	40	4	Pb	15	2
Cr	58	5	Pr	20.7	3.7
Cs	3.3	0.5	Rb	80	10
Cu	58	5	Sc	26	3
Dy	6.2	1.0	Sm	17	2
Er	2.80	0.55	Sn	3.2	0.5
Eu	3.9	0.5	Sr	2240	140
F	1300	100	Ta	0.5	0.1
Ga	17	2	Tb	1.5	0.2
Gd	11.5	2	Th	8	1
Ge	1.3	0.2	U	1.8	0.3
Hf	5.3	0.9	V	250	24
Ho	1.1	0.2	Y	30	3
La	82	10	Yb	2.5	0.3
Li	12	2	Zn	120	15
Lu	0.30	0.05	Zr	219	16
Mo	1.4	0.2			

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C)

Component / Element	mg/kg	Component / element	mg/kg
Ag	0.09	Tm	0.35
Au	0.004	H ₂ O ⁺	9300
B	15	LOI	7700
S _{tot}	150		

Table 3. **Mineral composition**

Mineral / phase	vol. %
Plagioclase	37.5
Pyroxene	26.9
Olivine	5.9
Potash feldspar	13.2
Ore minerals (titano-magnetit, magnetit)	5.3
Biotite	5.7
Apatite	1.5
Mesostasis (albite microlites, secondary and accessory minerals)	4.0

Table 4. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %	
	Analizette22	HELOS/BR
+80	0.03	–
-80...+71	0.04	0.010 \pm 0.003
-71...+63	0.06	0.03 \pm 0.01
-63...+50	0.45	0.84 \pm 0.14
-50...+40	3.75	2.25 \pm 0.46
-40	95.67	96.36 \pm 0.13

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Table 5. **Representative samples**

Element / Component	Analytical weight, g
Ba, P, B, Be, Ce, Cs, Cu, La, Nb, Ni, Nd, Hf, Pb, Rb, Sc, Sr, Sm, Ta, Tb, Th, Eu, Lu, Zr, U, Dy, Er	0.05
F, V, Cr	0.075
Mn, Fe _{tot} , FeO, Ti, Mg, Ca, Co, Ge, Ga, Mo, Sn, Zn, As, Sb, W, Ag	0.10
Al, Li	0.15
FeO, Si, Na, K, S _{tot}	0.20
LOI	1.0

Date of single batch issue: 20.02.2005.

CRM is issued in conformity with Certificate of certified reference material type approval No. **1195**, valid **untill**.

Certified Reference Materials
Quartz Diorite
GSO 6103-91 (SKD-1)

Description. The quartz diorite, a magmatic rock, was sampled in the South-East Baikal region on the left bank of Dzhida river opposite the Khuldat river mouth.

METROLOGICAL CHARACTERISTICS:

Table 1. Certified values (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	60.45	0.25	MgO	3.05	0.12
TiO ₂	0.86	0.05	MnO	0.086	0.005
Al ₂ O ₃	16.56	0.31	K ₂ O	2.98	0.11
Fe ₂ O _{3 tot}	5.55	0.12	Na ₂ O	3.57	0.15
FeO	3.79	0.15	P ₂ O ₅	0.17	0.01
CaO	4.84	0.20	LOI	1.59	0.07

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
B	46	8	Nd	24	4
Ba	720	120	Ni	33	3
Be	2.4	0.4	Pb	24	3
Ce	46	9	Rb	83	9
Co	17	2	Sc	15	2
Cr	58	6	Sm	4.8	0.7
Cs	2.9	0.5	Sn	4.3	0.8
Cu	39	6	Sr	410	50
Eu	1.3	0.2	Th	6.8	1
F	710	80	V	96	10
Ga	18	2	Y	21	4
La	27	5	Yb	2.1	0.4
Li	30	4	Zn	71	8
Lu	0.30	0.06	Zr	173	20
Nb	12	2			

ADDITIONAL INFORMATION:

Table 2. Information values (for material dried at 105°C)

Element	mg/kg	Element	mg/kg	Component	wt %
Ag	0.075	Mo	0.8	CO _{2 carb}	0.18
As	6	Pr	4.7	H ₂ O ⁻	0.14
Cl	110	Sb	0.92	H ₂ O ⁺	1.6
Dy	4	S _{tot}	130		
Er	2	Ta	0.8		
Gd	3.9	Tb	0.87		
Ge	1.4	Tm	0.3		
Hf	5	U	2		
Ho	0.6				

Table 3. **Mineral composition**

Mineral/phase	vol. %
Plagioclase	53.47
Quartz	14.86
Biotite	12.19
Potassic feldspar	10.81
Amphibole	7.85
Sphen	0.73

Table 4. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %
-80...+71	5.00
-71...+63	13.00
-63...+45	54.00
-45...+30	17.00
-30...+20	5.90
-20...+10	3.60
-10	1.50

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Table 5. **Representative samples**

Element / Component	Analytical weight, g
F	0.075
Mn, Fe _{tot} , FeO, Ti, Mg, Ca, Co, Ni, Ge, Ga, Mo, Zn, W, Ba, Be, Ce, Cs, Cu, La, Nb, Nd, Hf, Pb, Rb, Sc, Sr, Sm, Ta, Tb, U, Th, Eu, Lu, Zr, Dy, Er, Ho, V, Cr	0.10
Al, Li, P, B, Bi, Cd, Ag, As, Sb, Sn	0.15
FeO, Si, Na, K, S _{tot}	0.20
LOI	1.0

Date of single batch issue: 20.12.1990.

CRM is issued in conformity with Certificate of certified reference material type approval No. **2039**, valid **untill**.

Certified Reference Material
Svatonossite
GSO 3191-91 (SSv-1)

Description. The svatonossite, a rock of syenite composition, containing abundant garnet inclusions and discovered by the Finnish scientist P.Escola, was sampled on the Sviatoy Nos peninsula of Lake Baikal.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	57.86	0.29	MgO	1.25	0.07
TiO ₂	0.78	0.04	MnO	0.14	0.01
Al ₂ O ₃	16.68	0.25	K ₂ O	4.77	0.19
Fe ₂ O _{3 tot}	5.41	0.11	Na ₂ O	4.51	0.22
FeO	2.51	0.09	P ₂ O ₅	0.39	0.02
CaO	6.94	0.22			

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Ba	6900	700	Nb	20	4
Be	1.9	0.3	Nd	102	20
Ce	219	34	Ni	8.4	1.5
Co	8	1	Pb	21	4
Cr	16	2	Rb	56	9
Cu	5	1	Sc	4.0	0.7
Eu	4.5	0.8	Sm	16	3
F	820	90	Sr	5200	400
Ga	17	2	V	79	11
Hf	5	1	Y	25	5
La	108	17	Yb	2.3	0.4
Li	10.5	1.5	Zn	109	15
Lu	0.33	0.06	Zr	185	20
Mo	1.1	0.2			

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C)

Element	mg/kg	Element	mg/kg	Component	wt %
Ag	0.03	Pr	23	CO _{2carb}	0.20
As	12	S _{tot}	170	LOI	0.38
B	7	Sn	1.9	H ₂ O ⁻	0.05
Cs	1	Ta	1.8	H ₂ O ⁺	0.28
Dy	6.9	Tb	1.7		
Er	2.5	Th	12		
Gd	10	Tm	0.45		
Ge	1.2	U	2		
Ho	1				

Table 3. Mineral composition

Mineral / phase	vol. %
Potassic feldspar	40.31
Plagioclase	38.15
Monoclinic pyroxene	11.04
Hornblende	4.13
Garnet	3.16
Sphen	1.74
Ore minerals (magnetit)	0.46
Calcite	0.25
Apatite	0.11

Ore phase in accessory amounts presented ilmenit, pyrite, and galenit.

Table 4. Grain size composition (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %
-80...+71	3.0
-71...+63	3.0
-63...+45	21.0
-45...+30	28.0
-30...+20	19.5
-20...+10	15.5
-10	10.0

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Table 5. Representative samples

Element / Component	Analytical weight, g
Ba, P, B, Be, Ce, Cs, Cu, La, Nb, Ni, Nd, Hf, Pb, Rb, Sc, Sr, Sm, Ta, Tb, Th, Eu, Lu, Zr, U, Dy, Er, Ho	0.05
F, V, Cr	0.075
Mn, Fe _{tot} , FeO, Ti, Mg, Ca, Co, Ge, Ga, Mo, Sn, Zn, As, Sb, W, Ag	0.10
Al, Li	0.15
FeO, Si, Na, K, S _{tot}	0.20
LOI	0.45

Date of single batch issue: 20.12.1990.

CRM is issued in conformity with Certificate of certified reference material type approval No. **2040**, valid **untill**.

Certified Reference Material
Alkaline Agpaitic Granite
GSO 3333-85 (SG-3)

Description. The alkaline agpaitic granite is collected from the main phase rocks, the Khan-Bogda massif of agpaitic granites in Mongolia. These are medium- and coarse-grained alkaline aegirineriebeckite granite of a compact structure and hypidiomorphic-grained texture.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	74.76	0.15	MgO	0.1	0.02
TiO ₂	0.26	0.01	MnO	0.12	0.005
Al ₂ O ₃	10.64	0.07	K ₂ O	4.64	0.06
Fe ₂ O _{3 tot}	4.5	0.07	Na ₂ O	4.24	0.05
FeO	1.61	0.06	P ₂ O ₅	0.024	0.003
CaO	0.32	0.03	LOI	0.27	0.02

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
B	11	3	Nd	50	10
Ba	90	20	Ni	6	1
Be	5	1	Pb	10	2
Ce	90	10	Rb	140	10
Co	1.3	0.3	Sc	4.6	0.8
Cr	31	3	Sm	10	1
Cs	4.5	0.5	Sn	5	1
Cu	12	1	Sr	8	2
Eu	0.4	0.1	Ta	1.1	0.2
F	620	50	Tb	1.7	0.3
Ga	27	4	Th	8	1
Ge	2.2	0.4	U	1.8	0.3
Hf	12	2	V	6	1
La	45	5	Y	60	12
Li	52	4	Yb	7	1
Lu	0.9	0.2	Zn	140	20
Mo	1.7	0.4	Zr	470	50
Nb	17	2			

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C)

Component / Element	mg/kg	Component / Element	mg/kg
Ag	0.06	Sb	0.5
As	4	W	1.1
Dy	10	CO ₂	1000
Er	6	H ₂ O ⁺	3000
S _{tot}	160		

Table 3. Mineral composition

Mineral / phase	vol.%
K-feldspar, perthit	50–66
Quartz	27.5–44.0
Albit	1–2.5
Riebeckit	1.3–3.0
Aegirin	0.5–2.7
Accessory minerals (elpidit, astrophillit, water titanium silicates, synchisit, zircon secondary)	0.5–1.0

Table 4. Grain size composition (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %
-80...+60	2.2
-60...+50	3.6
-50...+40	5.5
-40	88.7

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Representative samples

Element / Component	Analytical weight, g
F	0.075
Be, Sc, V, Cr, Co, Ni, Cu, Zn, Pb, Ga, Ge, Rb, Sr, Y, Zr, Nb, Mo, Cs, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, W, Th, U, P, B,	0.10
Mn, Fe tot, FeO, Ti, Mg, Ca, Li, Sn, As, Sb, Ag	0.15
Al, Si, Na, K, Stot	0.20
LOI	1.0

Date of single batch issue: 25.12.1985.

CRM is issued in conformity with Certificate of certified reference material type approval No. **1981**, valid till **01.01.2031**.

Producers:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.
- Research Institute of Applied Physics, Irkutsk State University.

**Certified Reference Material
Subalkaline Granite
GSO 10135-2012 (SG-4)**

Description. The subalkaline granite is a rock belonging to the granitoids, collected in 1989 in the field of the granite massif Daura-Chentij and Khangai upland (или elevation) (Northern Mongolia, Mongolian People's Republic), characterized by high-potassium, low-calcium composition and appropriate transitional species from subalkaline to alkaline.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	73.8	0.6	MgO	0.079	0.014
TiO ₂	0.25	0.01	MnO	0.052	0.003
Al ₂ O ₃	12.6	0.3	K ₂ O	5.08	0.07
Fe ₂ O _{3 tot}	3.06	0.03	Na ₂ O	4.13	0.14
FeO	1.82	0.05	P ₂ O ₅	0.039	0.005
CaO	0.44	0.02	LOI	0.24	0.03

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Ba	123	16	Nd	84	14
Be	5.7	0.8	Ni	6.5	1.0
Ce	177	27	Pb	44	5
Co	0.9	0.2	Pr	22	3
Cr	29.4	3.4	Rb	194	8
Cs	6.7	0.7	Sc	1.9	0.4
Cu	10.4	1.1	Sm	19	3
Dy	14.2	1.6	Sn	7.4	1.4
Er	7.7	1.4	Sr	34	7
Eu	0.64	0.06	Ta	1.7	0.3
F	1140	170	Tb	2.5	0.3
Ga	26	4	Th	20	3
Gd	15	2	Tm	1.1	0.2
Ge	1.9	0.3	U	6.8	0.9
Hf	18	2	V	5.8	0.7
Ho	2.6	0.5	W	3.0	0.5
La	91	7	Y	77.2	8.0
Li	40	4	Yb	7.4	1.4
Lu	1.3	0.3	Zn	145	6
Mo	3.3	0.3	Zr	710	50
Nb	27	3			

ADDITIONAL INFORMATION:Table 2. **Information values** (for material dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component / Element	mg/kg	$\pm\Delta$
Ag	0.20	0.03
As	6.6	2.3
B	11	2
Cd	0.33	0.15
S _{tot}	150	80
Sb	0.6	0.4
H ₂ O ⁻	1200	300

Table 3. **Mineral composition**

Mineral / phase	vol. %
K-feldspar (orthoklas, mikroclin)	60–65
Quartz	25–30
Amphibole	3–5
Accessory minerals (magnetite, ilmenite, zircon, apatite, orthit, monazite, sphene, calcite)	≤ 0.5

Table 4. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt. %	
	Dry sift	Analysette22
-40	81	87
-40...+50	7	7.0
-50...+63	9	3.0
-63...+80	3	2.7
-80...+100	–	0.3

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Table 5. **Representative samples**

Element / Component	Analytical weight, g
Ba, P, B, Be, Ce, Cs, Cu, La, Nb, Ni, Nd, Hf, Pb, Rb, Sc, Sr, Sm, Ta, Tb, Th, Eu, Lu, Zr, U, Dy, Er, Ho	0.05
F, Mo, V, W, Co, Cr, Ge, Sn, Zn, As, Sb	0.075
Mn, Fe _{tot} , FeO, Ti, Mg, Ca, Li, Ag	0.10
Si, Al, Na, K, S _{tot}	0.20
LOI	1.0

Date of single batch issue: 01.08.2012.

CRM is issued in conformity with Certificate of certified reference material type approval No. **2830**, valid till **01.08.2042**.

Certified Reference Material
Synnyrit
GSO 10171-2012 (SSn-1)

Description. The rock average composition of the alkaline range of family pseudo-leucit feldspatoid syenite, was collected in 1985 at the Kalyumny area of Synnyrit deposit (North-Baikal region of Buryatia, Irkutsk Region).

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	55.0	0.4	MgO	0.18	0.02
TiO ₂	0.091	0.006	MnO	0.0093	0.0008
Al ₂ O ₃	22.5	0.4	K ₂ O	18.0	0.2
Fe ₂ O _{3 tot}	1.35	0.03	Na ₂ O	1.19	0.08
FeO	0.61	0.06	P ₂ O ₅	0.058	0.005
CaO	0.49	0.02	LOI	0.61	0.05

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Ba	2090	150	Nd	4.7	0.7
Be	0.63	0.1	Ni	2.5	0.5
Ce	12.3	1.4	Pr	1.3	0.2
Co	1.5	0.3	Rb	776	99
Cr	7.9	1.2	Sm	0.84	0.16
Cs	20	3	Sr	564	56
Cu	3.2	0.5	Tb	0.07	0.01
Eu	0.22	0.04	Th	0.31	0.05
Ga	22	2	V	12	2
Hf	0.12	0.02	Y	1.2	0.2
La	6.8	0.9	Yb	0.08	0.01
Li	3.9	0.3	Zn	13	2

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Element	mg/kg	$\pm\Delta$	Element / Component	mg/kg	$\pm\Delta$
Dy	0.28	0.03	Sc	0.46	0.17
Er	0.09	0.02	Sn	0.18	0.06
F	160	80	S _{tot}	250	70
Gd	0.56	0.07	Ta	0.030	0.006
Ge	0.48	0.07	Tl	0.6	0.1
Ho	0.04	0.01	Tm	0.013	0.003
Lu	0.012	0.003	U	0.07	0.02
Mo	0.38	0.09	W	0.26	0.07
Nb	0.3	0.1	Zr	4.0	1.1
Pb	1.6	0.4	H ₂ O ⁻	1100	200

Table 3. Mineral composition

Mineral / phase	vol. %
K-feldspar	~ 80
Pyroxene, mica	~ 10
Kalsilit, nephelin	~ 10

Accessory minerals: quartz, apatite, calcite, magnetite, orthit, monazite, fluorit, titano-magnetit, sphene, zircon, and intermetallic iron.

Table 4. Grain size composition (mass content of fractions in per cent)

Fraction size, µm	Yield of fractions, wt %	
	Dry sift	Analizette22
-63...+80	1.8	–
-50...+63	4.2	0.2
-40...+50	4.2	1.5
-40	89.8	98.3

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Table 5. Representative samples

Element / Component	Analytical weight, g
Ba, Be, Ce, Co, Cr, Cs, Cu, Eu, Ga, La, Li, Hf, Nd, Ni, Pr, Rb, Sm, Sr, Tb, V, Y, Yb, Dy, Er, Gd, Ge, Ho, Lu, Mo, Sc, Ta, U, Zr	0.05
F	0.075
Tm, Pb, P, Ca, Mg, Mn	0.10
Ti, Fe _{tot} , FeO, K, Th, Zn, Nb, Sn, Tl, W	0.15
Na, S _{tot}	0.2
H ₂ O, SiO ₂ , Al ₂ O ₃	0.4
LOI	1.0

Date of single batch issue: 01.11.2012.

CRM is issued in conformity with Certificate of certified reference material type approval No. **2884**, valid till **01.11.2041**.

Certified Reference Material
Metamorphic Schist
GSO 3191-85 (SSL-1)

Description. The metamorphic schist is sampled from the Upper Proterozoic outcrop of the Timan Ridge, Komi Autonomous Republic. This is quartz-chlorite-sericite schist with thread-like intercalations of coaly-clay composition, fine-bedded, strongly licated. It has a fine-banded, oolitic-like struture and granolepidoblastic texture.

METROLOGICAL CHARACTERISTICS:

Table 1. Certified values (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	63.40	0.23	MgO	2.52	0.04
TiO ₂	1.01	0.04	MnO	0.13	0.01
Al ₂ O ₃	16.71	0.20	K ₂ O	3.56	0.03
Fe ₂ O _{3 tot}	7.6	0.1	Na ₂ O	0.08	0.01
FeO	4.65	0.17	P ₂ O ₅	0.030	0.004
CaO	0.09	0.02	LOI	4.54	0.11

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
B	100	20	Pb	15	1
Ba	950	40	Rb	150	10
Be	3.5	0.7	Sc	22	2
Ce	90	20	Sr	39	5
Co	27	4	V	100	10
Cr	70	10	Y	48	6
Cu	46	8	Yb	5	1
Nb	16	1	Zn	100	20
Ni	45	6	Zr	230	10

ADDITIONAL INFORMATION:

Table 2. Information values (for material dried at 105°C)

Element	mg/kg	Element	mg/kg	Element	mg/kg
Cs	7	Li	60	Sn	4
Ga	15	Lu	0.6	Th	12
Ge	2	Mo	1.6	U	2

Table 3. Mineral composition

Mineral / phase	vol. %	Mineral / phase	vol. %
Sericite-muscovite	28.6	Chlorite	26.8
Quartz-feldspathic aggregate	23.4	Biotite	14.8
Albite	0.15	Ankerite	0.7
Ferric hydroxides	0.4	Rutile	0.9
Coaly substance	3.7	Sulphides and magnetite	0.05
Epidote-zoisite	0.15	Turmalin	grain

Table 4. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt. %
+80	0.5
+60...-80	3.2
+50...-60	6.8
+40...-50	4.6
-40	84.9

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Table 5. **Representative samples**

Element / Component	Analytical weight, g
LOI	0.5
Si, Al, Mg, FeO, K	0.2
All other certified element / components	0.1

Date of single batch issue: 28.12.1984.

CRM is issued in conformity with Certificate of certified reference material type approval No. **1978**, valid till **01.01.2030**.

Producers:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.
- Research Institute of Applied Physics, Irkutsk State University.

**Certified Reference Material
Limestone Dolomitized
GSO 3193-85 (SI-2)**

Description. The limestone dolomitized is sampled from the Upper Proterozoic rocks of the Timansky ridge, Komi Autonomous Republic. This stromatolitic limestone is partially dolomitized and marbled, contains admixtures of quartz, cherty, clay and micaceous minerals. The rock has a laminated, spotted and banded structure, and pelitomorphic, in place granular texture.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
SiO ₂	12.35	0.09	Ba	60	10
TiO ₂	0.09	0.01	Ce	31	18
Al ₂ O ₃	1.87	0.07	Co	2.2	0.2
Fe ₂ O _{3 tot}	2.48	0.08	Cr	13	3
FeO	1.89	0.04	Cu	4	1
CaO	38.5	0.4	Ni	7	2
MgO	6.04	0.16	Pb	16	2
MnO	0.28	0.02	Rb	15	1
K ₂ O	0.49	0.01	Sr	500	100
Na ₂ O	0.48	0.05	V	24	5
P ₂ O ₅	0.027	0.003	Zn	25	5
LOI	37.46	0.08	Zr	26	3

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C)

Element	mg/kg	Element	mg/kg
B	10	Sc	2
Be	1	Th	2
Cs	0.7	U	1
La	7	Y	9
Lu	0.1	Yb	1
Nb	8		

Table 3. **Mineral composition**

Mineral / phase	vol. %
Calcite	55.6
Dolomite	38.4
Quartz	2.5
Feldspar	0.4
Clay particles	0.7

The accessory amounts of ferric hydroxides, siliceous material, leucoxene, chlorite, tourmaline, rutile, zircon, hydroglimmer, monazite, sphene, magnetit are present in the rock.

Table 4. Grain size composition (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %
+80	0.8
-80...+60	4.3
-60...+50	4.7
-50...+40	5.4
-40	84.8

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Table 5. Representative samples

Element / Component	Analytical weight, g
LOI	0.5
Si, Al, Fe _{tot} , FeO, Mg, Ca, K	0.3
All other certified element / components	0.1

Date of single batch issue: 28.12.1984.

CRM is issued in conformity with Certificate of certified reference material type approval No. **1980**, valid till **01.01.2030**.

Producers:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.
- Research Institute of Applied Physics, Irkutsk State University.

**Certified Reference Material
Feldspar-Bearing Dolomite
GSO 3192-85 (SI-3)**

Description. The feldspar-bearing dolomite is sampled from the core material of the Upper Proterozoic metamorphic formations of the Timan ridge Komi Autonomous Republic. Macroscopically, these are pink, grey-pink with a brownish hue marbled rocks having a homogenous or fine-banded structure and medium-grained texture passing into porphyro- and heterogranoblastic one.

METROLOGICAL CHARACTERISTICS:

Table 1. Certified values (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
SiO ₂	19.81	0.09	Ba	410	60
TiO ₂	0.29	0.02	Co	12	3
Al ₂ O ₃	5.55	0.11	Cr	30	4
Fe ₂ O _{3 tot}	3.19	0.15	Cu	27	3
FeO	1.82	0.15	Ni	17	4
CaO	21.46	0.27	Pb	10	2
MgO	12.85	0.22	Rb	58	3
MnO	0.29	0.01	Sr	46	4
K ₂ O	2.74	0.04	Th	16	3
Na ₂ O	1.39	0.05	Zn	21	4
P ₂ O ₅	0.063	0.002	Zr	80	10
LOI	31.87	0.08			

ADDITIONAL INFORMATION:

Table 2. Information values (for material dried at 105°C)

Element	mg/kg	Element	mg/kg
B	15	Sc	10
Be	1.5	V	40
Ge	0.9	Y	20
La	13	Yb	2.5
Li	40		

Table 3. Mineral composition

Mineral / phase	vol.%	Mineral / phase	vol.%
Dolomite	53.8	Albite	13.7
K-feldspar	21.6	Quartz	1.5
Rutile	1.9	Aegirine	1.0
Ferric oxides	1.0	Sericite	1.3
Hydromicas	2.3	Calcite	0.6

The accessory amounts of sulphides, apatite, zircon, tourmaline, sphene, ilmenite, adular are present in the rock.

Table 4. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %
+80	0.4
-80...+60	3.9
-60...+50	5.2
-50...+40	4.7
-40	85.8

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Table 5. **Representative samples**

Element / Component	Analytical weight, g
LOI	4.0
Al, Mg, K, Ti, Ca	0.2
All other certified element / components	0.1

Date of single batch issue: 28.12.1984.

CRM is issued in conformity with Certificate of certified reference material type approval No. **1979**, valid till **01.01.2030**.

Producers:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.
- Research Institute of Applied Physics, Irkutsk State University.

**Certified Reference Material
Black Shale
GSO 8549-04 (SCHS-1)**

Description. The sample includes carbon-bearing pyrripyritized black shale of the Khomolkho suite, which is stratigraphically found in Late Proterozoic sedimentary metamorphic sequence. The samples is a composition of 10 separate samples, collected at different sites of the Vysochaishii deposit and the sequence along the Khomolkho river.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	61.21	0.27	MnO	0.057	0.006
TiO ₂	0.91	0.05	K ₂ O	3.72	0.12
Al ₂ O ₃	16.80	0.30	Na ₂ O	0.95	0.06
Fe ₂ O _{3 tot}	5.57	0.13	CO _{2 carb}	1.41	0.08
CaO	1.14	0.06	P ₂ O ₅	0.086	0.006
MgO	2.67	0.09	LOI	6.00	0.12

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Ag	0.10	0.02	Nb	11	2
As	40	7	Nd	28	5
Au	0.10	0.02	Ni	39	6
B	103	17	Pb	8.2	1.4
Ba	720	120	Rb	140	10
Be	2.0	0.4	Sc	23	4
Ce	58	11	Sm	5.7	0.9
Co	13	2	Sn	2.2	0.4
Cr	128	10	Sr	150	15
Cs	4.4	0.8	S _{tot}	6200	300
Cu	34	6	Ta	0.86	0.16
Dy	5.6	1.0	Tb	0.95	0.15
Eu	1.2	0.2	Th	8.2	1.2
Ga	21	2	U	2.1	0.2
Gd	6.1	1.1	V	148	18
Hf	4.1	0.7	Y	28	5
La	30	5	Yb	2.9	0.5
Li	56	6	Zn	96	11
Lu	0.44	0.07	Zr	176	16
Mo	1.7	0.3			

ADDITIONAL INFORMATION:Table 2. **Information values** (for material dried at 105°C)

Element	mg/kg	Element	mg/kg
Bi	0.3	Pd	0.0013
Cd	0.27	Pr	6.5
Er	3.3	Pt	0.0012
Ge	2.1	Tm	0.5
Ho	1.1	W	3.5

Element	wt %	Component	wt %
C _{org}	1.31	FeO	3.17
F	0.12	SO ₃	1.59

Mineral composition, vol. %

Terrigenous component: (rock-forming) quartz (10-60%), plagioclase (10-25%), microcline, biotite.

Accessory: tourmaline, zircon, sphene, apatite, ilmenite, leucoxene, epidote, garnet, disthen.

Ore mineral: pyrite, pyrrhotite, chalcopyrite, arsenopyrite, sphalerite, galena, magnetite, hematite.

Secondary minerals: chlorite, muscovite, siderite, ankerite, dolomite.

Cement (to 50-60 % of volume of black schist): it contains sericite (to 10 %), chlorite (to 5-20 %), muscovite, montmorillonite, α -cerolite, β -christobalite, analcime, braunite, siderite, ankerite.

Table 4. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %	
	Analizette22	HELOS/BR
+80	0.02	–
-80...+71	0.38	–
-71...+63	0.11	–
-63...+50	0.37	0.06 \pm 0.02
-50...+45	0.77	0.15 \pm 0.03
-45...+40	0.69	0.35 \pm 0.04
-40...+36	1.75	0.39 \pm 0.04
-36...+25	7.86	3.46 \pm 0.09
-25	88.31	95.59 \pm 0.19

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Table 5. **Representative samples**

Element / Component	Analytical weight, g
B, P, V, Cr, As, Nb, F	0.075 (and more)
Mg, Ca, Fe _{tot} , Na, K, Mn, Ti, Ba, Li, Ni, Co, W, Mo, Sn, Ga, Pb, Cu, Zn, Ag, Sb, Tl, Ge, Bi, Cd, Zr, Be, Eu, La, Rb, Sc, Sm, Th, Y	0.100 (and more)
Al, Cs	0.150 (and more)
Lu, Yb, Hf, U	0.200 (and more)
CO _{2 carb} , S _{tot}	0.300 (and more)
Si	0.400 (and more)
LOI, Dy, Ta, Tb, Ce, Gd, Au	0.500 (and more)

Date of single batch issue: 09.03.2004.

CRM is issued in conformity with Certificate of certified reference material type approval No. **3787**, valid **untill**.

Certified Reference Material
Black Shale (Ore of Sukhoy Log Gold-bearing Deposit)
GSO 8550-04 (SLg-1)

Description. material of the sample corresponds to the composition of rock mass within the industrial gold-bearing body. The sample included the sedimentary core from 4 bore holes, drilled on the Sukhoy Log deposit.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	57.60	0.27	MgO	3.06	0.09
TiO ₂	0.88	0.04	MnO	0.110	0.008
Al ₂ O ₃	15.53	0.33	K ₂ O	2.85	0.11
Fe ₂ O _{3 tot}	7.47	0.17	Na ₂ O	1.27	0.06
CaO	1.06	0.05	P ₂ O ₅	0.115	0.007

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Ag	0.47	0.08	Nd	25	4
As	46	8	Ni	50	7
Au	2.5	0.3	Pb	14.9	2.8
Ba	376	46	Pr	6.2	1.2
Ce	53	8	Rb	112	11
Co	20	3	Sc	20	3
Cr	116	8	Sm	5.4	0.8
Cs	4.0	0.7	Sr	142	15
Cu	39	7	S _{tot}	10200	500
Eu	1.2	0.2	Th	7.1	1.1
Ga	18	3	U	1.65	0.23
Gd	4.5	0.8	V	122	15
Hf	4.7	0.7	Y	26	4
La	28	5	Yb	2.7	0.4
Li	50	8	Zn	97	13
Lu	0.40	0.07	Zr	176	16
Nb	12	2			

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C)

Element	mg/kg	Element	mg/kg	Component	wt %
B	108	Pt	0.0022	FeO	5.11
Be	2.4	Rh	0.001	C _{org}	1.19
Cd	0.4	Sb	1	CO ₂	3.8
Dy	4.4	Sn	3.2	LOI	9.5
Er	2.4	Ta	0.7		
Ge	2.1	Tb	0.74		
Ho	0.92	Tm	0.33		
Mo	0.8	W	3.3		
Pd	0.0023				

Mineral composition, vol. %:

Terrigenous component: (rock-forming) quartz (10-60%), plagioclase (10-25%), microcline, biotite.

Accessory: tourmaline, zircon, sphene, apatite, ilmenite, leucoxene, epidote, garnet, disthen.

Ore minerals: pyrite, pyrrhotite, chalcopyrite, arsenopyrite, sphalerite, galena, magnetite, hematite

Secondary minerals: chlorite, muscovite, siderite, ankerite, dolomite and calcite-ferrous substratum.

Cement (to 50-60 % of the black schist bulk), it contains sericite (to 10 %) muscovite, montmorillonite, siderite, ankerite.

Table 3. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %	
	Analizette22	HELOS/BR
+80	0.03	–
-80...+71	0.04	–
-71...+63	0.06	0.020 \pm 0.004
-63...+50	0.14	0.370 \pm 0.010
-50...+45	1.42	0.410 \pm 0.004
-45...+40	1.23	0.770 \pm 0.010
-40...+36	1.60	0.800 \pm 0.004
-36...+25	7.30	5.33 \pm 0.02
-25	88.20	92.30 \pm 0.04

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 4. Before use it is recommended to shake the bottle with CRM.

Table 4. **Representative samples**

Element / Component	Analytical weight, g
Cs, La, Sm, Y, Yb	0.060 (and more)
Zr, Pb, F	0.075 (and more)
Fe _{tot} , K, Mn, Ti, Ba, Li, P, B, Ni, Co, V, Cr, W, Sn, Ga, Pb, Cu, Zn, Ag, Sb, As, Tl, Ge, Bi, Cd, Nb, Pr, Rb, Sr, Ce, Th	0.100 (and more)
Al, Mg	0.150 (and more)
Si, Ca	0.180 (and more)
Na, K, Hf, Nd	0.200 (and more)
Eu	0.400 (and more)
Gd, Lu, Sc, U	0.500 (and more)

Date of single batch issue: 09.03.2004.

CRM is issued in conformity with Certificate of certified reference material type approval No. **3788**, valid **untill**.

**Certified Reference Material
Garnet-biotite Plagiogneiss
GSO 8871-2007 (GBPg-1)**

Description. The garnet-biotite plagiogneiss (GBPg-1) was collected in the Semisosensky Bay area on the western coast of Olkhon island (Lake Baikal, Siberia). This rock forms small schlieren-like inclusions within the granitized country rocks and has a gradual transition into them.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	64.92	0.27	MgO	2.59	0.07
TiO ₂	0.70	0.02	MnO	0.069	0.005
Al ₂ O ₃	15.90	0.16	K ₂ O	2.25	0.08
Fe ₂ O _{3 tot}	6.06	0.14	Na ₂ O	3.56	0.11
FeO	4.14	0.13	P ₂ O ₅	0.080	0.005
CaO	2.85	0.06	LOI	0.76	0.04

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Ba	910	50	Nd	43.8	7.3
Be	0.97	0.18	Ni	60	5
Ce	104	11	Pb	14.2	2.0
Co	19.7	1.5	Pr	11.5	1.9
Cr	182	14	Rb	55	5
Cs	0.32	0.05	Sc	14.3	2.2
Cu	31	3	Sm	6.9	0.7
Dy	3.3	0.5	Sr	364	45
Er	2.1	0.3	Ta	0.40	0.07
Eu	1.8	0.3	Tb	0.6	0.1
F	573	50	Th	11.3	1.5
Ga	18.5	2.3	Tl	0.31	0.06
Gd	4.7	0.6	Tm	0.33	0.05
Hf	6.2	1.0	U	0.8	0.1
Ho	0.69	0.10	V	98	13
La	53	8	Y	17.8	2.8
Li	21	3	Yb	2.02	0.24
Lu	0.31	0.05	Zn	81	11
Mo	1.7	0.3	Zr	234	23
Nb	10.0	1.6			

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C)

Element	mg/kg	Element	mg/kg	Element	mg/kg	Component	mg/kg
Ag	0.09	Cd	0.1	S _{tot}	74	CO ₂	1300
As	2.0	Ge	1.1	Sn	0.6	H ₂ O ⁺	11000
B	10.0	Sb	0.05	W	0.3		

Table 3. **Mineral composition**

Mineral / phase	vol. %
Plagioclase	15–65
Biotite	10–30
Quartz	20–45
Garnet	2–20
Accessory minerals (ortit, trace magnetit, zircon)	≤ 1

Table 4. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %		
	Analizette22	HELOS/BR	
+80	0.53	0.04	± 0.01
-80...+71	0.55	0.16	± 0.02
-71...+63	1.43	0.49	± 0.06
-63...+50	2.72	1.99	± 0.11
-50...+45	1.79	1.59	± 0.03
-45...+40	1.47	2.20	± 0.02
-40...+36	2.57	2.08	± 0.01
-36...+25	10.38	9.21	± 0.04
-25	78.56	82.25	± 0.23

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Table 5. **Representative samples**

Element / Component	Analytical weight, g
Al, Fe _{tot} , Mn, K, Rb, Sc, Ga, Er, Gd, Nb, Tb, Th, Yb, Ba, Sr, Cu, Hf, Li, Mo, Ni, Ta, La, Nd, V, Zn, Ce, Dy, Eu, Pb, Pr, Sm, Y, Zr	≤0.050
Ti, Mg, Ca, Co, Cr	≤0.075
Na, Cs, Be, P, B, F, Ag, Ge, Ho, Lu, U	≤0.1
FeO, Tl, As, Sb, Cd, Tm	≤0.15
Si	≤0.25
LOI	2.0

Date of single batch issue: 31.03.2007.

CRM is issued in conformity with Certificate of certified reference material type approval No. **2645**, valid till **31.03.2032**.

Certified Reference Material
Baikal Bottom Silt
GSO 7126-94 (BIL-1)

Description. Baikal bottom silt was taken from a depth of 1600 m in the middle basin of Lake Baikal from the upper part of the stratigraphic column. The material corresponds to the recent lacustrine sediments.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	61.07	0.26	MgO	2.00	0.07
TiO ₂	0.69	0.03	MnO	0.40	0.02
Al ₂ O ₃	13.57	0.13	K ₂ O	2.21	0.08
Fe ₂ O _{3 tot}	7.02	0.15	Na ₂ O	1.96	0.07
FeO	1.60	0.09	P ₂ O ₅	0.345	0.015
CaO	1.85	0.09	LOI	8.34	0.18

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
As	18	3	Nd	39	5
B	34	6	Ni	54	6
Ba	710	70	Pb	21	3
Be	2.7	0.4	Rb	93	5
Ce	80	5	Sc	13	2
Co	18	2	Sm	7	1
Cr	66	4	Sn	3.2	0.5
Cs	6	1	Sr	266	30
Cu	52	7	S _{tot}	1650	130
Eu	1.4	0.2	Ta	0.84	0.15
F	600	60	Tb	0.9	0.1
Ga	16	2	Th	12.7	1.3
Ge	1.4	0.2	U	12.0	1.1
Hf	3.9	0.7	V	110	10
La	45	6	Y	30	4
Li	37	4	Yb	2.9	0.4
Lu	0.40	0.05	Zn	96	14
Mo	2.9	0.5	Zr	156	13
Nb	12	2			

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C)

Element	mg/kg	Element	mg/kg	Component	wt %
Ag	0.17	Ho	1	C _{org}	2.24
Au	0.004	Pr	8	CO ₂	0.07
Dy	4.6	Sb	0.95	SO ₃	0.35
Er	2.6	Se	0.8	H ₂ O ⁺	4.5
Gd	5.8	Tm	0.42	H ₂ O ⁻	2.15
Hg	0.03	W	4.3		

Mineral composition, vol. %: the sample consists mainly of pelitic and fine aleurite mud.

The diatom ooze amounts to 16% of the total sample. The fine fraction is largely composed of allothigenous hydromica, montmorillonite and kaolinite. The coarse fraction of the silt comprises quartz, amphibole, pyroxene, mica, feldspar, chlorite, garnet and the accessory minerals i.e. sphene and zircon. In addition to diatom ooze the authigenous minerals includes hydrogoethite, vernadite, psilomelane, beraunite, hydrotroilite, melnikovite, pyrite and vivianite.

Table 3. Grain size composition (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %		
	Analizette22	HELOS/BR	
-80...+71	0.4	–	
-71...+63	0.5	0.010	± 0.001
-63...+50	1.5	0.21	± 0.08
-50...+45	0.8	0.36	± 0.03
-45...+40	0.2	0.65	± 0.05
-40...+36	1.3	0.68	± 0.05
-36...+25	3.0	3.91	± 0.07
-25	92.3	94.18	± 0.19

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 4. Before use it is recommended to shake the bottle with CRM.

Table 4. Representative samples

Element / Component	Analytical weight, g
Cr, Zn	0.050
Ti, P, Ni	0.070
K, B, Co, V, W, Mo, Sn, Pb, Cu, Ag, Sb, As, Ge, Bi, Nb, F	0.075
Fe _{tot} , Na, Mn, Ga, Tl, Lu, Ta, U, Th, Hf, Nd, Tb, Yb, Y, Cs,	0.100
La, Ba, Zr, Cd, Ce, Li, Rb, Eu, Sm, Sr, Sc, Be	
Al	0.120
Ca	0.130
Mg	0.210
Si	0.320
S _{tot} , FeO	0.400
LOI	1.0

Date of single batch issue: 30.06.1994.

CRM is issued in conformity with Certificate of certified reference material type approval No. **4001**, valid till **01.07.2024**.

**Certified Reference Material
Baikal Bottom Sediments
GSO 7176-95 (BIL-2)**

Description: Baikal bottom sediments BIL-2 consists in the composition of 13 separate subsamples, lifted from internal Maloye More basin (Lake Baikal's straits). The material corresponds to the recent lacustrine sediments and is characterized by specific sand – aleuro – pelitic poor sorted composition due to the conditions of shallow and small size basin.

METROLOGICAL CHARACTERISTICS:

Table 1. Certified values (for materials dried at 105°C) and their 95 % confidence intervals ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	62.46	0.26	MgO	3.12	0.12
TiO ₂	0.76	0.03	MnO	0.12	0.01
Al ₂ O ₃	14.22	0.22	K ₂ O	1.51	0.05
Fe ₂ O _{3 tot}	5.39	0.11	Na ₂ O	3.11	0.09
FeO	3.50	0.14	P ₂ O ₅	0.139	0.008
CaO	7.09	0.21	LOI	1.78	0.08

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Ba	530	80	Rb	39	7
Co	17	2	Sc	19	3
Cr	158	10	Sn	3.7	0.7
Cu	18	3	Sr	580	30
La	19	3	V	105	10
Li	8.5	1.6	Y	24	4
Nb	10	2	Yb	2.7	0.5
Ni	31	6	Zn	64	11
Pb	14	2	Zr	204	22

ADDITIONAL INFORMATION:

Table 2. Information values (for material dried at 105°C)

Element	mg/kg	Component / Element	mg/kg
Ag	0.04	Lu	0.41
B	12	Mo	1.6
Be	1.3	Nd	21
Ce	41	Sm	4.3
Eu	1.4	Th	4.8
F	380	U	3
Ga	13	CO ₂	7400
Ge	1.3	H ₂ O ⁻	2200
Hf	6.7	SO ₃	500

Mineral composition, vol. %: More than half of mass share of sample makes up the leucocratic minerals-quartz, feldspar, K-feldspar. Essential group (more than 35%) contains melanocratic minerals: monoclinic pyroxenes (more often, diopsides), amphibole (basically, hornblende) and biotite. Ore minerals (about 5%) consist of ilmenite, magnetite and as the accessories – martite-hematite, limonite, leucoxene and pyrite. At the appreciable quantities scapolite, carbonates (basically, calcite), epidote, zoisite, garnet, sphene and apatite are presented. Rutil and zircon are fixed as the accessories. The rare earths phosphates-monazite and xenotime are noted as the individual grains as well as the metamorphogeneous minerals-staurolite, disthen and corundum.

Mineral / phase	vol. %	Mineral / phase	vol. %
Quartz	24.9	Ilmenit	3.4
Plagioklase	20.7	Carbonates	0.9
K-feldspar	8.5	Skapolith	1.0
Ortho-pyroxene	0.4	Granate	0.4
Klino-pyroxene	10.1	Epidot	0.7
Amphibol	18.5	Zoisit	0.5
Biotit	8.1	Sphene	0.2
Magnetit	0.9	Apatit	0.2

Table 3. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %		
	Analizette22	HELOS/BR	
-80...+71	0.38	0.10	± 0.001
-71...+63	0.47	0.33	± 0.01
-63...+50	1.65	1.91	± 0.02
-50...+45	1.27	1.81	± 0.01
-45...+40	0.74	2.62	± 0.01
-40...+36	2.19	2.53	± 0.01
-36...+25	9.52	11.17	± 0.04
-25	83.78	79.55	± 0.09

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 4. Before use it is recommended to shake the bottle with CRM.

Table 4. **Representative samples**

Element / Component	Analytical weight, g
Mn, Ba, Li, P, B, Ni, V, Cr, Mo, Sn, Pb, Zn, Pb, Ag, Ge, Cd, F	0.075
Al, Fe _{tot} , K, Ti, Co, Ga, Cu, As, Zr, Nb, Sc	0.10
Mg, Na, W, Tl, Bi	0.15
Si, Rb	0.19
FeO	0.20
Ca, Sr	0.38
Y, Yb	0.46
La	0.51
LOI	1.0

Date of single batch issue: 01.03.1995.

CRM is issued in conformity with Certificate of certified reference material type approval No. **4374**, valid till **01.03.2025**.

**Certified Reference Material
Carbonate Background Silt
GSO 3131-85 (SGH-1)**

Description. The carbonate silt with a background content elements-admixtures is sampled from stream of the Aldan region, Yakutia. It consists of fragmentary material of rocks and minerals presenting the hydrological network of the region.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	47.0	0.2	MnO	0.30	0.01
TiO ₂	0.50	0.02	K ₂ O	2.26	0.07
Al ₂ O ₃	9.48	0.14	Na ₂ O	0.53	0.02
Fe ₂ O _{3 tot}	5.92	0.04	P ₂ O ₅	0.13	0.01
CaO	7.76	0.10	LOI	20.10	0.13
MgO	6.06	0.11			

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
B	70	20	Ni	40	4
Ba	620	30	Pb	20	3
Be	2.4	0.4	Rb	61	3
Co	21	2	Sc	11	2
Cr	68	6	Sn	5	1
Cs	4	1	Sr	250	40
Cu	37	4	V	110	10
Ga	11	1	Y	22	3
Li	96	4	Zn	50	10
Mo	2.4	0.4	Zr	130	10
Nb	11	1			

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C)

Element	mg/kg	Element	mg/kg
Ag	0.2	Ge	1.2
As	16	La	38
Cd	2.3	S	370
Ce	60	Yb	2.8

Table 3. **Mineral composition,**

Mineral / phase	vol.%
Rock fragments	50
Dolomite	25
Quartz	24
Microcline	1
Limonite	grain

Table 4. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %
+63	1.8
-63...+50	1.1
-50	97.1

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Table 5. **Representative samples**

Element / Component	Analytical weight, g
LOI	1.0
Fe _{tot} , Mn, Ti	≤ 0.15
Pb, Sn, Zn, Ge, Rb, Be, Mo, Zr, Cu, Li, Y, Yb, Nb, Ga, F	≤ 0.10
All other certified components	≤ 0.05

Date of single batch issue: 01.10.1984.

CRM is issued in conformity with Certificate of certified reference material type approval No. **1917**, valid till **01.10.2024**.

Producers:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.
- Research Institute of Applied Physics, Irkutsk State University.

**Certified Reference Material
Terrigenous Background Silt
GSO 3132-85 (SGH-3)**

Description. The terrigenous background silt is sampled in Oymyakon region, Yakutia. This sample consists of eluvial loose sediments (subsoil horizon) and fragments of rocks and minerals.

METROLOGICAL CHARACTERISTICS:

Table 1. Certified values (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	60.54	0.20	MnO	0.13	0.01
TiO ₂	0.98	0.03	K ₂ O	2.43	0.08
Al ₂ O ₃	16.46	0.19	Na ₂ O	1.61	0.05
Fe ₂ O _{3 tot}	8.76	0.08	P ₂ O ₅	0.19	0.01
CaO	0.41	0.03	LOI	6.78	0.12
MgO	1.60	0.05			

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
B	70	10	Nb	13	2
Ba	570	40	Ni	72	5
Be	2.8	0.5	Pb	23	3
Co	30	4	Rb	77	5
Cr	140	10	Sc	20	5
Cs	4.1	0.5	Sn	3.9	0.5
Cu	48	3	Sr	130	10
Ga	16	2	V	180	20
Ge	1.6	0.2	Y	30	3
La	43	4	Yb	4.3	0.6
Li	71	4	Zn	120	10
Mo	2.5	0.3	Zr	220	10

ADDITIONAL INFORMATION:

Table 2. Information values (for material dried at 105°C)

Element	mg/kg
Ag	0.17
As	38
Cd	0.2
Ce	60
S _{tot}	270
Sb	1.9

Table 3. Mineral composition

Mineral / phase	vol. %
Fragments of rocks	95
Anorthoclase	4.9
Quartz	0.1

Table 4. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %
+63	2.6
-63...+50	2.0
-50	95.4

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Table 5. **Representative samples**

Element / Component	Analytical weight, g
LOI	0.40
Si, Fe _{tot} , S _{tot}	0.25
Ti, Mn, Be, Nb, Sn, Ga, Ge, Mo, F, As, Ag, V, F, Sr	≤ 0.10
Al, Ca, K, Mg, Na, K, P, B, Ba, Li, Co, Cs, Ni, Rb, Sc, Sr, Pb, Ce, Cr, Zn, Cu, Zr, Yb, La, Y	≤ 0.05

Date of single batch issue: 01.10.1984.

CRM is issued in conformity with Certificate of certified reference material type approval No. **1918**, valid till **01.10.2024**.

Producers:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.
- Research Institute of Applied Physics, Irkutsk State University.

**Certified Reference Material
Anomalous Silt
GSO 3133-85 (SGH-5)**

Description. The anomalous silt is a composite sample of river. It is collected in the Aldan, Oymyakon and Tompon regions of Yakutia. It has high content of some elements-admixtures. The sample consists of fragments of rocks and minerals.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	60.85	0.14	MnO	0.087	0.003
TiO ₂	0.62	0.01	K ₂ O	3.56	0.09
Al ₂ O ₃	14.40	0.11	Na ₂ O	2.33	0.06
Fe ₂ O _{3 tot}	5.45	0.10	P ₂ O ₅	0.18	0.01
CaO	2.95	0.05	LOI	6.39	0.09
MgO	2.54	0.06			

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
B	60	10	Nb	17	4
Ba	910	70	Ni	36	3
Be	3.7	0.4	Pb	58	5
Ce	80	10	Rb	120	10
Co	13	1	Sc	17	4
Cr	88	6	Sn	5	1
Cs	5.8	0.6	Sr	280	30
Cu	190	10	V	110	10
Ga	16	2	Y	26	6
Ge	1.4	0.2	Yb	3.3	0.5
La	61	4	Zn	90	10
Li	37	3	Zr	230	20
Mo	10	2			

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C)

Element	mg/kg	Element	mg/kg
Ag	0.8	S	1000
As	430	Sb	15
Cd	1.5		

Table 3. **Mineral composition**

Mineral/phase	vol.%
Rock fragments	80
Quartz	15
Dolomite	5

Table 4. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %
+63	0.6
-63...+50	0.4
-50	99.0

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Table 5. **Representative samples**

Element / Component	Analytical weight, g
LOI	1.0
Si	0.2
Fe _{tot} , Mn, Pb, Sn, Nb, Cr, Cu, Mo, Ga, Ge, Ce, Zr, Be, La, F, Na, Ca, K, Ti	≤ 0.1
Al, Mg, P, B, Ba, Li, Co, Cs, Ni, Rb, Sc, Sr, V, Zn, Y, Yb	≤ 0.05

Date of single batch issue: 01.10.1984.

CRM is issued in conformity with Certificate of certified reference material type approval No. **1919**, valid till **01.10.2024**.

Producers:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.
- Research Institute of Applied Physics, Irkutsk State University.

Certified Reference Material
Carbonate-silicate Loose Sediments
GSO 3483-86 (SGHM-1)

Descriptions. The sample is collected from loose formations the subsoil horizon of background plot (the stream Mogut – a tributary of river Amga) in the Aldan region, Yakutia. It is a fine sand-clay fraction of eluvial-deluvial deposits.

METROLOGICAL CHARACTERISTICS:

Table 1. Certified values (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	45.59	0.29	MgO	5.82	0.10
TiO ₂	0.63	0.04	MnO	0.073	0.004
Al ₂ O ₃	11.60	0.13	K ₂ O	2.96	0.07
Fe ₂ O _{3 tot}	4.62	0.06	Na ₂ O	0.87	0.05
CaO	7.05	0.20	P ₂ O ₅	0.15	0.01

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Ba	470	70	Rb	90	10
Be	2.0	0.4	S	500	100
Co	14	2	Sc	9	2
Cr	66	7	Sn	3.7	0.5
Cu	48	5	Sr	300	40
Ga	12	2	V	90	10
La	32	2	Y	23	7
Li	100	10	Yb	2.5	0.3
Nb	12	2	Zn	50	10
Ni	33	6	Zr	140	20
Pb	16	3			

ADDITIONAL INFORMATION:

Table 2. Information values (for material dried at 105°C)

Element	mg/kg	Component	wt %
Ag	0.5	Fe ₂ O ₃	2.8
As	40	FeO	1.3
Au	0.04	LOI	20.33
B	90		
Cd	2		
Mo	1.5		

Table 3. Mineral composition

Mineral / phase	vol.%	Mineral / phase	vol.%
Quartz	30–35	Accessory minerals (apatite, goethite, hydrogoethite, ferric hydroxides)	1–2
Dolomite		Feldspar	15–20
Clay particles	15–20	Coaly substance	3–5
Calcite	10–15	Micas	3–5
Pyroxenes	1–2	Magnesite	1–2
Magnetite	2–4		

Table 4. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %
+80	0.02
-80...+60	0.60
-60...+50	2.02
-50...+40	2.88
-40	94.48

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Table 5. **Representative samples**

Element / Component	Analytical weight, g
Si, Al, Fe _{tot} , Ti, P, Ca, Mg, Mn, K, Na, P, B, Ba, Sr, Cu, Pb, Zn, Co, Ni, Cr, V, Be, As, Cd, Bi, Sb, W, Ag, B, Ge, La, Li, Sc, Rb, Y, Yb, Ga, Nb, Zr, Cs, Ce, Pr, Nd, Sm, Eu, Gd, Tb Dy, Ho, Er, Tm, Lu, Hf, Th, U, Tl, F	≤ 0.1
Mo, Sn, Ta	≤ 0.15
S _{tot} , FeO	0.5
LOI	1.0

Date of single batch issue: 30.04.1986.

CRM is issued in conformity with Certificate of certified reference material type approval No. **4749**, valid till **01.05.2026**.

Producers:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.
- Research Institute of Applied Physics, Irkutsk State University.

Certified Reference Material
Alumosilicate Loose Sediments
GSO 3484-86 (SGHM-2)

Description. The sample collected from loose layers of the subsoil horizon of the background plot (the upper reaches of the Creek Artyk-Yuryakh near Olshanskogo pass) in Oymyakonsky district of Yakutia. This is beautiful sandy-clay fraction of the eluvial-deluvial deposits of aluminosilicate composition.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	51.95	0.28	MgO	1.53	0.07
TiO ₂	0.85	0.04	MnO	0.071	0.002
Al ₂ O ₃	16.76	0.18	K ₂ O	2.51	0.07
Fe ₂ O _{3 tot}	6.33	0.09	Na ₂ O	1.37	0.05
CaO	1.13	0.06	P ₂ O ₅	0.18	0.01

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Ba	580	60	Pb	16	3
Be	2.3	0.4	Rb	100	10
Co	18	3	S	500	100
Cr	120	10	Sc	15	5
Cu	52	4	Sn	4.4	0.4
Ga	17	2	Sr	200	20
La	34	3	V	140	20
Li	60	5	Y	30	10
Nb	12	1	Yb	3.2	0.4
Ni	58	3	Zn	90	10

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C)

Element	mg/kg	Component	wt %
Ag	0.7	Fe ₂ O ₃	3.5
As	40	FeO	2.2
Au	0.025	LOI	17.17
B	80		
Cd	1.9		
Mo	3		
Zr	180		

Table 3. **Mineral composition**

Mineral/phase	vol.%	Mineral/phase	vol.%
Quartz	30–35	Clay particles	10–15
Feldspar	20–25	Micas	5–8
Dolomite	10–15	Siderite	2–4
Coal substance	6–8		

Table 4. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %
+80	0.02
-80...+60	0.86
-60...+50	3.90
-50...+40	7.40
-40	87.82

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Table 5. **Representative samples**

Element / Component	Analytical weight, g
Si, Al, Fe _{tot} , Ti, P, Ca, Mg, Mn, K, Na, B, Ba, Sr, Cu, Pb, Zn, Co, Ni, Cr, V, Be, As, Cd, Bi, Sb, W, Ag, Ge, La, Li, Sc, Rb, Y, Yb, Ga, Nb, Zr, Cs, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Lu, Hf, Th, U, Tl, F	≤ 0.1
Mo, Sn, Ta	≤ 0.15
S _{tot} , FeO	0.5
LOI	1.0

Date of single batch issue: 30.04.1986.

CRM is issued in conformity with Certificate of certified reference material type approval No. **4750**, valid till **01.05.2026**.

Producers:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.
- Research Institute of Applied Physics, Irkutsk State University.

Certified Reference Material
Carbonate-silicate Loose Sediments
GSO 3485-86 (SGHM-3)

Description. The sample is composed of 3 parts of loose sediments from the horizon of the subsoil, selected on the objects of the Central Aldan region (the gold-bearing Lebedinskoe Deposit, the Seligdara Deposit of apatites, the Toroczkai ore occurrence of molybdenum). This is fine sandy-clay fraction of the eluvial-deluvial sediments having a high content of some impurity elements.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	25.07	0.29	MgO	11.70	0.14
TiO ₂	0.27	0.01	MnO	0.50	0.03
Al ₂ O ₃	5.03	0.10	K ₂ O	1.13	0.04
Fe ₂ O _{3 tot}	10.59	0.20	Na ₂ O	0.61	0.04
CaO	17.76	0.22	P ₂ O ₅	1.82	0.05

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Ag	2.6	0.4	Ni	19	3
Au	1.3	0.1	Rb	40	10
Ba	350	60	S	500	100
Be	2.5	0.5	Sc	9	2
Co	11	2	Sn	4	1
Cr	28	3	Sr	180	20
Cu	260	20	V	70	10
Ga	9	2	Y	40	10
La	260	20	Yb	3.3	0.5
Li	20	2	Zn	140	10
Mo	29	3	Zr	70	10

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C)

Element	mg/kg	Component	wt %
As	90	Fe ₂ O ₃	10.2
B	14	FeO	0.24
Bi	10	LOI	25.14
Cd	3.5		
Nb	7		
Pb	200		

Table 3. Mineral composition

Mineral /phase	vol.%	Mineral /phase	vol.%	Mineral /phase	vol.%
Quartz	10–15	Micas	1–2	Goethite, hydrogoethite	4–6
Feldspar	15–20	Pyroxenes	2–4	Ferric hydroxides	1–2
Calcite	25–30	Apatite	2–4	Accessory minerals	1–2
Magnesite	10–15	Magnetite	1–2	Coal substance, Clay	< 1
Dolomite	20–25			particles	

Table 4. Grain size composition (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %
+80	0.01
-80...+60	0.23
-60...+50	1.82
-50...+40	2.94
-40	95.00

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Table 5. Representative samples

Element / Component	Analytical weight, g
Si, Al, Fe _{tot} , Ti, P, Ca, Mg, Mn, K, Na, P, B, Ba, Sr, Cu, Pb, Zn, Co, Ni, Cr, V, Be, As, Cd, Bi, Sb, W, Ag, B, Ge, La, Li, Sc, Rb, Y, Yb, Ga, Nb, Zr, Cs, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Lu, Hf, Th, U, Tl, F Mo, Sn, Ta	≤ 0.1
S _{tot} , FeO	≤ 0.15
LOI, Au	0.5
	1.0

Date of single batch issue: 30.04.1986.

CRM is issued in conformity with Certificate of certified reference material type approval No. **4751**, valid till **01.05.2026**.

Producers:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.
- Research Institute of Applied Physics, Irkutsk State University.

Certified Reference Material
Alumosilicate Loose Sediments
GSO 3486-86 (SGHM-4)

Description. The sample consists of two parts of the carbonate-silicate loose sediments from a subsoil horizon deposits in Oymyakonsky district of Yakutia (the gold-antimony ore occurrence Kinas and the deposit of tungsten Alaskitovoye). This is fine sandy-clay fraction of the eluvial-deluvial deposits having a high content of some impurity elements.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	70.54	0.27	MgO	0.48	0.03
TiO ₂	0.62	0.03	MnO	0.11	0.01
Al ₂ O ₃	11.29	0.12	K ₂ O	2.21	0.04
Fe ₂ O _{3 tot}	5.24	0.07	Na ₂ O	1.67	0.05
CaO	0.52	0.04	P ₂ O ₅	0.28	0.02

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
B	160	20	Pb	110	10
Ba	390	60	Rb	190	30
Be	3.6	0.6	S	4300	300
Cd	9	2	Sb	170	30
Co	9	2	Sc	8	2
Cr	76	5	Sn	400	100
Cu	250	30	Sr	200	30
Ga	16	2	V	60	10
La	32	4	Y	16	6
Li	150	10	Yb	2.4	0.2
Nb	17	4	Zn	390	40
Ni	25	2	Zr	210	20

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C)

Element	mg/kg	Element	mg/kg	Component	wt %
Ag	34	Bi	70	Fe ₂ O ₃	3.5
As	7000	Cs	18	FeO	1.3
Au	0.11	Mo	3	LOI	5.44

Table 3. **Mineral composition**

Mineral / phase	vol.%
Quartz	45–55
Feldspar	35–45
Micas	2–6
Accessory minerals	2–4

Accessory minerals: coal substance, clay particles, siderite, pyroxenes, ferric hydroxides, arsenopyrite, pyrite, wolframite, tourmaline, fluorite.

Table 4. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %
+80	0.03
-80...+60	0.28
-60...+50	0.87
-50...+40	2.27
-40	96.55

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 5. Before use it is recommended to shake the bottle with CRM.

Table 5. **Representative samples**

Element / Component	Analytical weight, g
Si, Al, Fe _{tot} , Ti, P, Ca, Mg, Mn, K, Na, P, B, Ba, Sr, Cu, Pb, Zn, Co, Ni, Cr, V, Be, As, Cd, Bi, Sb, W, Ag, B, Ge, La, Li, Sc, Rb, Y, Yb, Ga, Nb, Zr, Cs, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Lu, Hf, Th, U, Tl, F	≤ 0.1
Mo, Sn, Ta	≤ 0.15
S _{tot} , FeO	≤ 0.2
LOI	1.0

Date of single batch issue: 30.04.1986.

CRM is issued in conformity with Certificate of certified reference material type approval No. **4752**, valid till **01.05.2026**.

Producers:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.
- Research Institute of Applied Physics, Irkutsk State University.

**Certified Reference Material
Float Concentrate of Gold-bearing Ore
GSO 2739-83 (SZK-3)**

Description. The float concentrate is a typical product of flotation of gold-bearing ore with a relatively low gold content.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Element	wt %	$\pm\Delta$
Ag	0.00057	0.00003
As	8.0	0.1
Au	0.0034	0.0001
S	26.0	0.2
Sb	0.020	0.002

ADDITIONAL INFORMATION:

Table 2. **Mineral composition**

Mineral / phase	vol. %
Quartz	10
Micas, feldspars, clay minerals	16
Carbonates	4
Coal substance	2
Pyrite	40.5
Arsenopyrite	25.5
Other sulphides	0.8
Accessory minerals	1.2

Table 3. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %
+80	0.03
-80...+60	0.14
-60...+50	0.60
-50	99.43

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. Before use it is recommended to shake the bottle with CRM. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 4. The average result of CRM analysis obtained from two parallel definitions should not differ from the values of certified characteristics more than the allowed acceptable errors between the results given in Table 4 for Au (taking into account the analyzed CRM).

Table 4. Representative samples and acceptable errors between the results

Element	Analytical weight, g	Acceptable error, %
Au	0.1	0.00022
	1	0.00021
	5	0.0002
	15	0.0002
	50	0.0002

CRM fulfils the condition of homogeneity for determination concentrations of other certified elements (Ag, As, S, Sb) using analytical weight at least 0.1 g (Table 5).

Table 5. Acceptable errors between the results

Element	Acceptable error, %
Ag	0.0001
As	0.16
Sb	0.006
S	0.4

Date of single batch issue: 30.09.1983.

CRM is issued in conformity with Certificate of certified reference material type approval No. **3785**, valid **untitled**.

Producers:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.
- Research Institute of Applied Physics, Irkutsk State University.

**Certified Reference Material
Gold-bearing Ore
GSO 8815-2006 (SZR-3)**

Description. Sample SZR-3 is produced by a consecutive dilution of CRM of float concentrate SZK-3 (GSO 2739-83) with barren rock, which is sandstone with clarke content of gold.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Element	wt %	$\pm\Delta$
Ag	0.0000715	0.0000009
As	1.000	0.009
Au	0.000425	0.000011
S	3.27	0.07
Sb	0.00260	0.00041

ADDITIONAL INFORMATION:

Table 2. **Mineral composition**

Mineral/phase	vol. %
Quartz	29.0
Micas, feldspars, clay minerals	31.3
Carbonates	28.8
Coal substance	1.4
Pyrite	5.1
Arsenopyrite	3.2
Chalcopyrite	0.06
Sphalerite	0.04
Grey ore	0.06
Accessories	1.0

Table 3. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %
+80	0.2
-80...+63	7.2
-63...+50	15.3
-50	77.3

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. Before use it is recommended to shake the bottle with CRM. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 4. The average result of CRM analysis obtained from two parallel definitions should not differ from the values of certified characteristics more than the allowed acceptable errors between the results given in Table 4 for Au (taking into account the analyzed CRM).

Table 4. Representative samples and acceptable errors between the results

Element	Analytical weight, g	Acceptable error, %
Au	1	0.00009
	5	0.00007
	15	0.00005
	50	0.00004

CRM fulfils the condition of homogeneity for determination concentrations of other certified elements (Ag, As, S, Sb) using analytical weight at least 0.1 g (Table 5).

Table 5. Acceptable errors between the results

Element	Acceptable error, %
Ag	0.00001
As	0.04
Sb	0.0007
S	0.12

Date of single batch issue: 01.12.2006.

CRM is issued in conformity with Certificate of certified reference material type approval No. **2263**, valid till **01.12.2031**.

Producer: Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.

**Certified Reference Material
Gold-bearing Ore
GSO 8816-2006 (SZR-4)**

Description. Sample SZR-4 produced by series of consecutive dilution of the CRM float concentrate SZK-3 (GSO 2739-83) with barren rock, which is sandstone with clarke content of gold.

METROLOGICAL CHARACTERISTICS:

Table 1. Certified values (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Element	wt %	$\pm\Delta$
Ag	0.0000360	0.0000003
As	0.500	0.004
Au	0.000213	0.000005
S	1.64	0.03
Sb	0.00135	0.00016

ADDITIONAL INFORMATION:

Table 2. Mineral composition

Mineral / phase	vol.%
Quartz	31.4
Micas, feldspars, clay minerals	31.6
Carbonates	31.0
Coal substance	1.2
Pyrite	2.5
Arsenopyrite	1.6
Chalcopyrite	0.03
Sphalerite	0.02
Grey ore	0.03
Accessories	1.0

Table 3. Grain size composition (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %
+80	0.8
-80...+63	2.8
-63...+50	21.9
-50	74.5

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. Before use it is recommended to shake the bottle with CRM. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 4. The average result of CRM analysis obtained from two parallel definitions should not differ from the values of certified characteristics more than the allowed acceptable errors between the results given in Table 4 for Au (taking into account the analyzed CRM).

Table 4. Representative samples and acceptable errors between the results

Element	Analytical weight, g	Acceptable error, %
Au	1	0.00009
	5	0.00007
	15	0.00005
	50	0.00004

CRM fulfils the condition of homogeneity for determination concentrations of other certified elements (Ag, As, S, Sb) using analytical weight at least 0.1 g (Table 5).

Table 5. Acceptable errors between the results

Element	Acceptable error, %
Ag	0.00001
As	0.04
Sb	0.0007
S	0.12

Date of single batch issue: 01.12.2006.

CRM is issued in conformity with Certificate of certified reference material type approval No. **2263**, valid till **01.12.2031**.

Producer: Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.

Certified Reference Material
Coal Ash of KATEK
GSO 7125-94 (ZUK-1)

Description. The brown coal ash of the Kansk-Achinsk basin was collected from the layered sequence of fine-dispersed sediments of the pond-collector ash removal system of the Galachinskaia heatpower station in Bratsk city.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	35.80	0.30	MgO	6.70	0.10
TiO ₂	0.35	0.01	MnO	0.094	0.005
Al ₂ O ₃	6.79	0.14	K ₂ O	0.51	0.02
Fe ₂ O _{3 tot}	6.28	0.08	Na ₂ O	0.22	0.02
FeO	0.40	0.04	CO ₂	13.20	0.25
CaO	20.91	0.21	P ₂ O ₅	0.059	0.003

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Ag	0.16	0.03	Nd	20	3
B	97	14	Ni	49	6
Ba	2250	230	Pb	13	3
Be	2.9	0.5	Rb	15	2
Ce	38	5	Sc	11	1
Co	16	2	Sm	4.1	0.5
Cr	45	5	Sn	2.7	0.5
Cu	45	7	Sr	3300	300
Eu	0.9	0.1	S _{tot}	1700	100
Ga	9	1	Tb	0.68	0.12
Ge	2.2	0.4	Th	5.8	1.0
Hf	2.6	0.4	U	3.3	0.4
La	20	3	V	61	8
Li	32	4	Y	29	4
Lu	0.40	0.05	Yb	2.6	0.3
Mo	1.4	0.2	Zn	65	7
Nb	8.4	1.5	Zr	119	15

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C)

Element	mg/kg	Element	mg/kg	Component	wt %
As	10	Hg	0.03	C _{org}	1.33
Au	0.003	Ho	0.87	SO ₃	0.40
Cs	1.1	Pr	4.3	LOI	21.29
Dy	3.8	Ta	0.53	H ₂ O ⁺	5.74
Er	2.4	Tm	0.38	H ₂ O ⁻	2.41
F	230	W	1.1		
Gd	4.2				

Mineral composition, vol. %:

The sample consists of three mineral associations. The first contains new formed minerals: calcite, magnesite, gypsum, ettringite, tobermorite, brownmillerite, melilites, wollastonite, monticellite, alite and $\text{Ca}_4\text{Al}_2\text{O}_7 \cdot \text{H}_2\text{O}$, $\text{Ca}_3\text{Si}_2\text{O}_7$, $13\text{Al}_2\text{O}_3 \cdot 6\text{SO}_3 \cdot \text{H}_2\text{O}$ compounds. The sample involves the glass phase of variable composition. The sample contains also some non-altered primary minerals: coal particles, quartz, feldspars, pyroxenes, hornblendes, ore minerals and burnt clay.

Table 3. **Grain size composition** (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %		
	Analizette22 COMPACT		HELOS/BR
+63	–		0.05 ± 0.01
-63...+50	0.10	±0.05	0.59 ± 0.07
-50...+40	0.8	±0.3	1.76 ± 0.02
-40...+25	12.2	±1.5	6.68 ± 0.11
-25	86.9	± 1.8	90.92 ± 0.18

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 4. Before use it is recommended to shake the bottle with CRM.

Table 4. **Representative samples**

Element / Component	Analytical weight, g
K, Ti, P, Ag, B, Cr, Ge, Pb, Sn, V, Zr, F	0.075
Si, Mn, Ba, Bi, Co, Cu, Mo, Nb, Ni, Sb, W, Be, Y, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Th, U, Hf, Cs, Sr, Sc,	0.1
Al, Na,	0.14
Ca, Fe _{tot} , As, Cd, Ga, Li, Tl, Zn,	0.15
Mg, S _{tot} ,	0.23
LOI	1.0

Date of single batch issue: 30.06.1994.

CRM is issued in conformity with Certificate of certified reference material type approval No. **4000**, valid till **01.07.2016**.

Producer: Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.

Certified Reference Materials
Coal Ash of Azey
GSO 7177-95 (ZUA-1)

Description: The sample is fly ash from the combustion of brown coal Azey sky deposits of the Irkutsk coal basin, selected from dry ash handling system for one of the boilers of Novo-Irkutsk heatpower plant (Irkutsk).

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	58.68	0.26	CaO	4.88	0.19
TiO ₂	0.60	0.02	MgO	1.48	0.08
Al ₂ O ₃	27.07	0.33	MnO	0.059	0.004
Fe ₂ O _{3 tot}	5.48	0.12	K ₂ O	0.59	0.03
FeO	1.59	0.09	Na ₂ O	0.14	0.01

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Ba	280	40	Pb	35	6
Be	11	2	Rb	22	3
Ce	138	25	Sc	27	5
Co	25	4	Sn	11	2
Cr	99	8	Sr	403	33
Cu	176	18	V	145	15
La	70	10	Y	87	17
Li	96	9	Yb	7.8	1.3
Mo	7.4	1.3	Zn	77	13
Nb	34	6	Zr	330	20
Ni	66	10			

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C)

Element	mg/kg	Component / element	mg/kg
Ag	0.15	Sm	15
B	440	Th	45
Bi	2.1	U	15
Cs	3.3	W	3.7
Eu	2.6	H ₂ O ⁻	1300
F	170	P ₂ O ₅	640
Ga	21	SO ₃	180
Ge	2.7	LOI	5600
Hf	13		

Mineral composition, vol. %:

The sample consists of three mineral associations: crystalline, glassy and organic materials. The crystalline phases contains both unaltered primary and new formed minerals: K-feldspars, plagioclase (including the anorthite), quartz, garnet, magnetite, hematite, calcite, kaolinite, metakaolinite, wollastonite, mullite and anhydrite. The glass phases consists of variable siderophilic ($\text{Fe}_2\text{O}_3+\text{MnO}+\text{TiO}_2$), high in $\text{SiO}_2+\text{Al}_2\text{O}_3$ and midrange in $\text{CaO}+\text{MgO}$ components. The organic matter contains coke, semicoke and small pieces of unburned coal.

Table 3b. Grain size composition (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %	
	Analizette22 COMPACT	HELOS/BR
+63	–	0.08 \pm 0.03
-63...+50	0.10 \pm 0.05	0.73 \pm 0.06
-50...+40	0.6 \pm 0.2	2.98 \pm 0.03
-40...+25	9.6 \pm 1.1	12.48 \pm 0.16
-25	89.7 \pm 1.3	83.73 \pm 0.18

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 4. Before use it is recommended to shake the bottle with CRM.

Table 4. Representative samples

Element / Component	Analytical weight, g
Na, Mn, P, B, Cr, Cu, Ni, Sb, V, Zn, Ge, Zr, F	0.075
Ti, Be, Bi, Co, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Nb, Sn, W, Y, Th, U, Hf, Cs, Sc, Rb	0.1
Fe_{tot}	0.12
Na	0.14
K, Ba, Sr, Ag, As, Cd, Ga, Li, Mo, Pb, Tl	0.15
Si	0.26
Al	0.33
Ca,	0.38
Mg	0.51
S_{tot} , LOI, H_2O^-	1.0

Date of single batch issue: 01.03.1995.

CRM is issued in conformity with Certificate of certified reference material type approval No. **4375**, valid till **01.03.2015**.

Producer: Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.

Certified Reference Material
Coal Fly Ash
GSO 9237-2008, COOMET CRM 0093-2010-RU (ZUK-2)

Description. The sample is made from fly ash from burning brown coal (grade B-2 according to GOST 25543-88) Berezovsky cut the Kansk-Achinsk basin, processed at Berezovskaya heatpower plant. COOMET CRM ZUK-2 is admitted to be applied without any limitations in Armenia, Belarus, Bulgaria, Kazakhstan, Kyrgyzstan, Lithuania, Moldova and Ukraine.

METROLOGICAL CHARACTERISTICS:

Table 1. Certified values (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component / element	wt %	$\pm\Delta$
SiO ₂	15.6	0.3	K ₂ O	0.36	0.03
TiO ₂	0.59	0.02	Na ₂ O	0.67	0.05
Al ₂ O ₃	9.7	0.2	LOI	8.5	0.2
Fe ₂ O _{3 tot}	5.1	0.1	Ba	0.86	0.09
CaO	43.8	0.5	Sr	0.83	0.07
MgO	5.5	0.2	S _{tot}	3.48	0.03
MnO	0.22	0.01			

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Be	2.9	0.5	Rb	13	3
Ce	37	5	Sb	3.0	0.5
Co	26	2	Sc	8.6	0.9
Cr	42	4	Sm	3.2	0.2
Cu	51	7	Tb	0.45	0.06
Ga	15	3	Th	7.0	0.9
Hf	3.3	0.5	U	3.1	0.4
La	20	2	V	63	7
Lu	0.26	0.02	Y	15	2
Nb	7.8	1.1	Yb	1.5	0.2
Nd	17	1	Zn	76	6
Ni	68	8	Zr	130	20
Pb	22	4			

ADDITIONAL INFORMATION:

Table 2. Information values (for material dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$	Element / Component	mg/kg	$\pm\Delta$
Ag	0.2	–	Hg	0.1	–	Tm	0.25	0.02
As	8.0	–	Ho	0.57	0.07	FeO	3000	1000
Cs	1.2	0.3	Li	9	–	CO ₂	29000	5000
Dy	2.7	0.2	Mo	3.0	0.9	P ₂ O ₅	240	50
Er	1.4	0.5	Pr	4.2	0.4			
Eu	0.8	0.2	Sn	3.2	0.2			
Gd	3.3	0.5	Ta	0.61	0.04			
Ge	6	–	Tl	0.4	–			

Table 3. Mineral composition

Chemical formula	Mineral / Phase	vol.%
CaO	Lime	10.7
CaSO ₄	Anhydrite	10.8
Ca(SO ₄)*(H ₂ O) _{0.5}	Hemihydrate	1.6
SiO ₂	Quartz	6.4
MgO	Periclase	4.4
CaCO ₃	Calcite	5.9
CaCO ₃	Aragonite	10.6
Al ₆ Ca ₄ O ₁₂ (SO ₄)		3.2
Ca(OH) ₂	Portlandite	2.9
Ca ₃ Al ₂ O ₆		7.3
(Fe,Al,Mg) ₃ O ₄	Spinel	0.8
Fe ₂ O ₃	Hematite	0.9
Ca ₂ (Fe,Al)O ₅		6.8
Ca ₂ SiO ₄	Larnite	4.5
–	Glass phase	23.2

Table 4. Grain size composition (mass content of fractions in per cent)

Fraction size, μm	Yield of fractions, wt %			
	Analizette22 COMPACT		HELOS/BR	
+63	–	–	0.010	± 0.001
-63...+50	0.10	±0.05	0.91	± 0.03
-50...+40	0.7	±0.2	2.16	± 0.03
-40...+25	7.9	±1.2	7.61	± 0.04
-25	91.3	± 1.5	89.31	± 0.10

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample presented in the Table 4. Before use it is recommended to shake the bottle with CRM.

Element / Component	Analytical weight, g
Al, K, Mn, Sr, Ag, B, Bi, Cr, Ni, Pb, Sb, Sn, V, Zr, Si, Na, P, F	0.05 0.075
Ti, As, Be, Ga, Li, Mo, Nb, Tl, Y, Zn, Ge, Co, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Th, U, Hf, Cs, Sc, Rb	0.10
Mg, Cu	0.12
Cd, W	0.15
Na	0.14
Ba	0.28
Ca, Fe _{tot} , S _{tot} , CO ₂ , LOI, FeO	0.4

Date of single batch issue: 20.12.2008.

CRM is issued in conformity with Certificate of certified reference material type approval No. **3387**, valid till 01.02.2019.

Producers:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.
- Institute of Chemistry and Chemical Technology, Siberian Branch of Russian Academy of Sciences.

Certified Reference Material
Concentrate of Magnetic Cenospheres
GSO 9234-2008, COOMET CRM 0094-2010-RU (KMC-1)

Description. The sample is a concentrate of magnetic cenospheres extracted from the ash from the combustion of coal of the Kuznetsk basin at the Moscow heatpower plant 22. COOMET CRM KMC-1 is admitted to be applied without any limitations in Armenia, Belarus, Bulgaria, Kazakhstan, Kyrgyzstan, Lithuania, Moldova and Ukraine.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	63.7	0.5	MgO	0.86	0.05
TiO ₂	0.74	0.02	MnO	0.039	0.002
Al ₂ O ₃	25.9	0.3	K ₂ O	2.9	0.2
Fe ₂ O _{3 tot}	2.85	0.07	Na ₂ O	0.48	0.03
FeO	1.67	0.09	P ₂ O ₅	0.076	0.007
CaO	1.19	0.07			

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Ba	840	40	Ni	30	6
Be	4.6	0.6	Pb	17	3
Ce	115	10	Rb	116	11
Co	7.6	0.7	Sc	13	2
Cr	59	4	Sm	8.4	0.9
Cs	12	2	Sr	217	15
Cu	33	4	Th	19	2
Eu	1.5	0.2	U	4.3	0.6
Hf	7.1	1.3	V	60	5
La	60	6	Y	34	5
Lu	0.56	0.07	Yb	3.5	0.4
Nb	19	2	Zn	28.0	3.3
Nd	48	3	Zr	260	20

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Element	mg/kg	$\pm\Delta$	Element / component	mg/kg	$\pm\Delta$
Dy	6	1	Sb	0.5	–
Er	3.5	1.1	Sn	1.6	–
Ga	11	2	Ta	1.5	–
Gd	7.3	1.4	Tb	1.1	0.3
Ho	1.2	0.3	Tl	0.5	–
Li	42	–	Tm	0.5	0.2
Mo	16	4	CO ₂	4300	1000
Pr	13	3	LOI	9200	800

Table 3. Mineral composition

Chemical formula	Mineral / Phase	vol. %
SiO ₂	Quartz	2.5
CaCO ₃	Calcite	0.6
(Fe,Al,Mg) ₃ O ₄	Spinel	0.3
Al ₆ Si ₂ O ₁₃	Mullite	5.9
–	Glass phase	90.7

INSTRUCTION FOR USE:

The material does not require additional sample preparation, but provides for the implementation of the conditions of the homogeneity of the impurity distribution when using a representative sample of not less than 0.15 g.

Date of single batch issue: 20.12.2008.

CRM is issued in conformity with Certificate of certified reference material type approval No. **3384**, valid till 01.02.2019.

Producers:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.
- Institute of Chemistry and Chemical Technology, Siberian Branch of Russian Academy of Sciences.

Certified Reference Material
Concentrate of Magnetic Cenospheres
GSO 9235-2008, COOMET CRM 0095-2010-RU (KMC-2)

Description. The sample is made of magnetic cenospheres extracted from the ash obtained by burning coal of the Kuznetsk basin (type B-2 according to GOST 25543-88) at Belovskaya thermal power station. COOMET CRM KMC-2 is admitted to be applied without any limitations in Armenia, Belarus, Bulgaria, Kazakhstan, Kyrgyzstan, Lithuania, Moldova and Ukraine.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
SiO ₂	64.1	0.5	MnO	0.049	0.003
TiO ₂	0.78	0.01	K ₂ O	3.5	0.1
Al ₂ O ₃	19.3	0.2	Na ₂ O	1.33	0.04
Fe ₂ O ₃ tot	4.04	0.07	P ₂ O ₅	0.19	0.01
CaO	2.77	0.08	CO ₂	0.51	0.04
MgO	1.64	0.08			

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Ba	890	130	Ni	35	5
Be	2.8	0.3	Pb	20	2
Ce	89	6	Rb	135	5
Co	11	1	Sc	15	2
Cr	66	4	Sm	7.2	0.6
Cs	8.6	1.2	Sr	480	22
Cu	34	3	Tb	0.92	0.18
Eu	1.4	0.2	Th	14	2
Ga	9.3	1.0	U	4.6	0.4
Hf	6.9	1.3	V	102	8
La	46	4	Y	33	2
Lu	0.53	0.07	Yb	3.3	0.4
Nb	15	1	Zn	50	2
Nd	39	2	Zr	246	8

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$	Component	wt %	$\pm\Delta$
Ag	0.2	–	Li	55	–	FeO	2.4	0.2
As	11	3	Mo	3.4	–	LOI	1.6	0.1
Dy	5.5	1.0	Pr	10	–			
Er	3.0	–	Sb	1.3	–			
Gd	6.7	1.0	Sn	2.3	0.5			
Ge	0.9	–	Ta	1.2	0.3			
Hf	6.9	1.3	Tl	0.7	0.2			
Ho	1.1	0.4	Tm	0.5	0.1			
F	0.2	–	S _{tot}	0.07	–			

Table 3. Mineral composition

Chemical formula	Mineral / Phase	vol. %
SiO ₂	Quartz	2.9
CaCO ₃	Calcite	0.8
(Fe,Al,Mg) ₃ O ₄	Spinel	0.3
–	Glass phase	94.1
(Si,Al)O ₂		1.6
Al ₆ Si ₂ O ₁₃	Mullite	0.3

INSTRUCTION FOR USE:

The material does not require additional sample preparation, but provides for the implementation of the conditions of the homogeneity of the impurity distribution when using a representative sample of not less than 0.15 g.

Date of single batch issue: 20.12.2008.

CRM is issued in conformity with Certificate of certified reference material type approval No. **3385**, valid till 01.02.2019.

Producers:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.
- Institute of Chemistry and Chemical Technology, Siberian Branch of Russian Academy of Sciences.

Certified Reference Material
Concentrate of Magnetic Microspheres
GSO 9236-2008, COOMET CRM 0096-2010-RU (KMM-1)

Description. The sample is made of magnetic microspheres extracted from fly ash obtained from burning brown coal (grade B2 according to GOST 25543-88) Berezovsky field of the Kansk-Achinsk basin at Berezovskaya thermal power station-1. COOMET CRM KMM-1 is admitted to be applied without any limitations in Armenia, Belarus, Bulgaria, Kazakhstan, Kyrgyzstan, Lithuania, Moldova and Ukraine.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Component	wt %	$\pm\Delta$	Element	wt %	$\pm\Delta$
SiO ₂	7.7	0.3	Ba	0.38	0.03
TiO ₂	0.21	0.02	S _{tot}	0.86	0.04
Al ₂ O ₃	2.6	0.1	Sr	0.17	0.01
CaO	8.2	0.3			
K ₂ O	0.12	0.02			
Na ₂ O	0.27	0.02			

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Ce	11	1	Rb	3.8	0.4
Co	23	5	Sc	2.5	0.5
Cr	67	8	Sm	1.0	0.2
Cu	28	4	Th	1.4	0.3
Hf	0.97	0.12	V	26	4
La	5.7	0.8	Y	5.6	0.7
Lu	0.10	0.01	Yb	0.50	0.08
Ni	62	7	Zn	38	7
Pb	3.5	0.6	Zr	39	5

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 105°C) and their **95 % confidence intervals** ($\pm\Delta$)

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Be	0.7	0.3	Nd	5.3	0.9
Cs	0.21	0.03	Pr	1.3	0.2
Dy	1.0	0.1	Sb	0.3	–
Er	0.6	0.1	Sn	1	–
Eu	0.5	–	Ta	0.15	–
Ga	3	1	Tb	0.16	0.04
Gd	1.2	0.2	Tl	0.06	–
Ho	0.19	0.04	Tm	0.09	0.01
Mo	4.6	1.8	U	1.0	0.2
Nb	3.1	1.0			

Table 2. *Continued*

Component	wt %	$\pm\Delta$	Component	wt %	$\pm\Delta$
Fe ₂ O _{3 tot}	78.4	1.7	CO ₂	0.64	0.12
FeO	15.4	0.7	P ₂ O ₅	0.036	0.006
MgO	1.3	0.2	LOI	0.42	0.50
MnO	0.082	0.005			

Table 3. **Mineral composition**

Chemical formula	Mineral / Phase	vol.%
SiO ₂	Quartz	3.0
(Fe,Al,Mg) ₃ O ₄	Spinel	51.0
Fe ₂ O ₃	Hematite	19.3
–	Residual phases	26.7

INSTRUCTION FOR USE:

The material does not require additional sample preparation, but provides for the implementation of the conditions of the homogeneity of the impurity distribution when using a representative sample of not less than 0.15 g.

Date of single batch issue: 20.12.2008.

CRM is issued in conformity with Certificate of certified reference material type approval No. **3386**, valid till 01.02.2019.

Producers:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.
- Institute of Chemistry and Chemical Technology, Siberian Branch of Russian Academy of Sciences.

Certified Reference Material
Leaf of Birch (*Betulus folium*)
GSO 8923-2007, COOMET CRM 0067-2008-RU (LB-1)

Description. The sample was prepared from autumnal fallen leaves of a birch, which had been gathered in the dry sunny weather in the birch grove on the outskirts of Irkutsk city away from the used roads. COOMET CRM LB-1 is admitted to be applied without any limitations in Armenia, Belarus, Bulgaria, Georgia, Kyrgyzstan, Slovakia and Ukraine.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 70°C) and their **95 % confidence intervals** ($\pm\Delta$)

Element	wt %	$\pm\Delta$	Element	wt %	$\pm\Delta$
Al	0.083	0.010	Na	0.018	0.003
Ba	0.023	0.002	P	0.154	0.006
Ca	1.60	0.09	Si	0.40	0.07
Fe	0.073	0.007	S _{tot}	0.10	0.02
K	0.71	0.04	Sr	0.0072	0.0007
Mg	0.44	0.03	Ti	0.0059	0.0012
Mn	0.093	0.007			

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
As	0.23	0.03	Ni	5.8	0.8
Br	3.2	0.4	Pb	3.7	0.5
Cd	0.16	0.03	Rb	13.7	0.9
Ce	1.50	0.12	Sb	0.057	0.011
Co	0.79	0.06	Sc	0.30	0.04
Cr	4.3	0.7	Sm	0.132	0.015
Cs	0.085	0.008	Tb	0.022	0.003
Cu	7.3	0.6	Th	0.22	0.03
Eu	0.026	0.005	U	0.082	0.012
Ga	0.48	0.08	V	2.1	0.4
Hg	0.037	0.006	W	0.30	0.03
La	0.82	0.09	Y	0.69	0.06
Lu	0.011	0.001	Yb	0.074	0.007
Nd	0.69	0.06	Zn	94	6

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 70°C) and their **95 % confidence intervals** ($\pm\Delta$)

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Be	0.05	–	Mo	0.16	0.06
Dy	0.12	0.01	Nb	0.20	0.03
Er	0.07	0.01	Pr	0.19	0.02
Gd	0.15	0.04	Sn	0.19	0.09
Ge	0.09	0.02	Ta	0.02	–
Hf	0.06	0.01	Tl	0.023	0.005
Ho	0.026	0.003	Tm	0.011	0.003
Li	0.73	0.09	Zr	5.5	1.6

Table 2. *Continued*

Element	wt %	$\pm\Delta$	Element / component	wt %	$\pm\Delta$
B	0.005	0.001	N	1.7	–
C	48	–	O	40	–
Cl	0.045	0.009	LOI	94.3	–

Table 3. **Grain size composition** (mass content of fractions in per cent)

Fraction size, mm	Yield of fractions, wt %
+0.125...-0.140	2.8
+0.100...-0.125	2.5
+0.080...-0.100	6.6
+0.063...-0.080	10.0
+0.040...-0.063	30.2
+0.025...-0.040	17.3
-0.025	30.6

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies the condition of homogeneity when using no less than representative weight 1 g. To overcome segregation effect due to storage and transportation, the material should be shaken appropriately before opening the bottle. If there is a need of sample intake below 1 g for an analytical method, it's need to weigh more than 1 g and mix in an agate mortar. Then take necessary weight.

STORAGE AND TRANSPORTATION CONDITIONS: CRM may be transported by any means of transport provided the air-tightness of package is ensured. After opening the certified reference material should be stored in an airtight container, protected from exposure to chemicals and moisture, at the temperature (20-25) °C and relative humidity less than 80 %.

Date of single batch issue: 30.11.2007.

CRM is issued in conformity with Certificate of certified reference material type approval **RU.E.04.999.A № 5228**, valid till 30.11.2027.

Producer:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.

Certified Reference Material
Mixture of Meadowherbs (Herbae pratenses)
GSO 8922-2007, COOMET CRM 0066-2008-RU (Tr-1)

Description. The mixture of meadowherbs was collected in a natural meadow in the village Khomutovo Irkutsk region in 1995. CRM Tr-1 is admitted to be applied without any limitations in Armenia, Belarus, Bulgaria, Georgia, Kyrgyzstan, Slovakia and Ukraine.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 70°C) and their **95 % confidence intervals** ($\pm\Delta$)

Element	wt %	$\pm\Delta$	Element	wt %	$\pm\Delta$
Al	0.037	0.005	Mg	0.24	0.02
Ca	0.67	0.03	Na	0.075	0.006
Cl	0.36	0.04	P	0.22	0.01
Fe	0.097	0.005	S _{tot}	0.18	0.02
K	1.38	0.03	Si	0.55	0.04

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
As	0.16	0.02	Nd	0.22	0.02
B	11.2	1.2	Ni	3.2	0.3
Ba	16.1	1.2	Pb	0.42	0.06
Br	9.0	1.0	Pr	0.060	0.009
Ce	0.50	0.05	Rb	15.7	0.4
Co	0.22	0.02	Sc	0.082	0.008
Cr	5.5	0.4	Sm	0.041	0.003
Cs	0.058	0.008	Sr	28.0	0.9
Cu	6.3	0.6	Th	0.055	0.005
Eu	0.0095	0.0014	Ti	33.3	5.3
Ga	0.16	0.02	V	0.61	0.09
La	0.26	0.09	Y	0.16	0.02
Mn	50.9	2.1	Yb	0.018	0.002
Mo	0.25	0.02	Zn	23.6	1.1

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 70°C) and their **95 % confidence intervals** ($\pm\Delta$)

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Be	0.014	–	Nb	0.082	–
Cd	0.051	0.011	Sb	0.019	0.005
Dy	0.04	–	Sn	0.09	–
Er	0.017	–	Ta	0.008	–
Gd	0.05	–	Tb	0.01	–
Ge	0.04	–	Tl	0.011	0.002
Hf	0.04	0.02	Tm	0.003	–
Hg	0.015	–	U	0.017	0.002
Ho	0.007	–	W	0.08	–
Li	0.55	0.09	Zr	0.9	–
Lu	0.0029	–			

Table 2. *Continued*

Element	wt %	±Δ	Element / component	wt %	±Δ
C	42	–	O	48	–
N	2.2	–	LOI	94.5	–

Table 3. **Grain size composition** (mass content of fractions in per cent)

Fraction size, mm	Yield of fractions, wt %
+0.125...-0.140	0.6
+0.100...-0.125	0.8
+0.080...-0.100	1.6
+0.063...-0.080	12.5
+0.040...-0.063	59.7
+0.025...-0.040	10.9
-0.025	13.9

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies the condition of homogeneity when using no less than representative weight 1 g. To overcome segregation effect due to storage and transportation, the material should be shaken appropriately before opening the bottle. If there is a need of sample intake below 1 g for an analytical method, it's need to weigh more than 1 g and mix in an agate mortar. Then take necessary weight.

STORAGE AND TRANSPORTATION CONDITIONS: CRM may be transported by any means of transport provided the air-tightness of package is ensured. After opening the certified reference material should be stored in an airtight container, protected from exposure to chemicals and moisture, at the temperature (20-25) °C and relative humidity less than 80 %.

Date of single batch issue: 30.11.2007.

CRM is issued in conformity with Certificate of certified reference material type approval **RU.E.04.999.A № 5227**, valid till 30.11.2027.

Producer:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.

Certified Reference Materials
Canadian Pondweed (*Elodea canadensis michaux*)
GSO 8921-2007, COOMET CRM 0065-2008-RU (EK-1)

Description. Canadian pondweed was collected in water area of south part of Mukhor bay (Maloe More strait) of Lake Baikal in the summer 1999, 2001 and 2002. CRM EK-1 is admitted to be applied without any limitations in Armenia, Belarus, Bulgaria, Georgia, Kyrgyzstan, Slovakia and Ukraine.

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 70°C) and their **95 % confidence intervals** ($\pm\Delta$)

Element	wt %	$\pm\Delta$	Element	wt %	$\pm\Delta$
Al	0.099	0.012	Mn	0.052	0.003
Ca	2.80	0.17	Na	0.68	0.05
Fe	0.26	0.01	P	0.24	0.03
K	3.22	0.16	S _{tot}	0.34	0.05
Mg	0.32	0.02			

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
As	0.76	0.12	Ni	3.7	0.4
Ba	78	7	Rb	3.5	0.3
Br	32.6	2.0	Sc	0.38	0.02
Ce	3.4	0.3	Sm	0.31	0.03
Co	1.5	0.1	Sr	174	9
Cr	5.1	0.5	Tb	0.041	0.005
Cs	0.108	0.008	Th	0.40	0.03
Cu	11.2	0.4	Ti	77	14
Eu	0.047	0.008	U	1.4	0.1
La	2.05	0.14	V	3.8	0.4
Li	1.44	0.18	Yb	0.074	0.006
Lu	0.019	0.003	Zn	20.6	1.4
Nd	1.59	0.17			

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 70°C) and their **95 % confidence intervals** ($\pm\Delta$)

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
Ag	0.017	–	Ho	0.047	0.008
B	33	10	Mo	1.2	–
Be	0.07	–	Pb	1.1	0.1
Bi	0.023	–	Pr	0.42	–
Cd	0.10	0.02	Sb	0.08	0.02
Dy	0.36	0.13	Se	0.3	–
Er	0.13	0.02	Sn	0.12	–
Ga	0.4	–	Ta	0.017	0.004
Gd	0.35	0.08	Tl	0.02	–
Ge	0.07	–	Tm	0.021	0.007
Hf	0.08	–	Y	1.3	–
Hg	0.03	–	Zr	2.6	–

Table 2. *Continued*

Element	wt %	$\pm\Delta$	Element / component	wt %	$\pm\Delta$
C	35	–	O	52	–
Cl	0.52	0.06	Si	1.1	0.2
N	2.3	–	LOI	86.6	–

Table 3. **Grain size composition** (mass content of fractions in per cent)

Fraction size, mm	Yield of fractions, wt %
+0.125...-0.140	1.6
+0.100...-0.125	10.1
+0.080...-0.100	11.8
+0.063...-0.080	10.7
+0.040...-0.063	17.7
+0.025...-0.040	10.4
-0.025	37.7

INSTRUCTION FOR USE: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample 1 g. Before use it is recommended to shake the bottle with CRM. If there is a need of sample intake below 1 g for an analytical method, it's need to weigh more than 1 g and mix in an agate mortar. Then take necessary weight.

STORAGE AND TRANSPORTATION CONDITIONS: CRM may be transported by any means of transport provided the air-tightness of package is ensured. After opening the certified reference material should be stored in an airtight container, protected from exposure to chemicals and moisture, at the temperature (20-25) °C and relative humidity less than 80 %.

Date of single batch issue: 30.11.2007.

CRM is issued in conformity with Certificate of certified reference material type approval **RU.E.04.999.A № 5226**, valid till 30.11.2027.

Producer:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.

Certified Reference Materials
Baikal Perch *Musculus Tissue (Perca fluviatilis (L.))*
GSO 9055-2008, COOMET CRM 0068-2009-RU (Bok-2)

Description. Sample was produced from the muscle tissue Baikal perch, caught in the bays of Lake Baikal and the Small Sea, Chivyrkuisky Bay, Delta Selenga and Angara River (Bratsk reservoir).

METROLOGICAL CHARACTERISTICS:

Table 1. **Certified values** (for materials dried at 70°C) and their **95 % confidence intervals** ($\pm\Delta$)

Element	wt %	$\pm\Delta$	Element	wt %	$\pm\Delta$
Ca	0.17	0.03	Na	0.28	0.01
Cl	0.28	0.02	P	0.95	0.05
K	1.55	0.08	S	1.1	0.2
Mg	0.103	0.012			

Element	mg/kg	$\pm\Delta$	Element	mg/kg	$\pm\Delta$
As	0.25	0.05	Fe	54	11
Br	49	5	Mn	1.7	0.3
Cd	0.010	0.001	Rb	22	1
Cs	0.08	0.02	Sr	2.8	0.3
Cu	1.9	0.3	Zn	23	2

ADDITIONAL INFORMATION:

Table 2. **Information values** (for material dried at 70°C) and their **95 % confidence intervals** ($\pm\Delta$)

Element	mg/kg	$\pm\Delta$
Co	0.06	–
Cr	0.8	–
Hg	0.5	0.2
Ni	0.5	–
Pb	0.37	0.14
Sb	0.31	0.10
Sc	0.006	0.001
Se	0.9	0.3

Component	wt %	$\pm\Delta$
LOI	95.0	–

Table 3. **Grain size composition** (mass content of fractions in per cent)

Fraction size, mm	Yield of fractions, wt %
+0.125...-0.140	7.35
+0.100...-0.125	19.38
+0.080...-0.100	15.91
+0.063...-0.080	13.27
+0.040...-0.063	15.31
+0.025...-0.040	9.39
-0.025	19.39

INSTRUCTION FOR USE, STORAGE AND TRANSPORTATION CONDITIONS: CRM material does not require any additional preparation, except stipulated by the method of analysis. CRM satisfies homogeneity condition by using the minimum representative sample 0.5 g, Hg – 0.2 g. Before use it is recommended to shake the bottle with CRM.

CRM BOK-2 should be stored in a freezer before opening bottle.

If you want to select a portion of the material BOK-2, then take the bottle out of the freezer, opened, put into a clean glass (quartz) or glass-carbon cup, weight (more than necessary) and left in air for a few hours (from the evening til the morning next business day), in a fume hood, covered with filter paper to obtain equilibrium with the environment of a substance (temperature and humidity). Close the bottle tightly and return to freezer. When the substance reaches the ambient temperature, select the required analytical weight. These analytical weights are selected for the preparation of solutions for methods AES-ICP, FAES, AAS, MS-ICP, determination of mercury by cold vapor or spectrophotometry. Excessive residue from glass cups discarded as food waste.

CRM may be transported by any means of transport provided the air-tightness of package is ensured.

Date of single batch issue: 01.07.2008.

CRM is issued in conformity with Certificate of certified reference material type approval No. **3018**, valid till 01.07.2018.

Producer:

- Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences.