



Approved by General Administration of Quality Supervision,

Inspection and Quarantine of the People's Republic of China

GBW07601- GBW07605



Certificate of Certified Reference Material

Vegetable and Human Hair



Date of Certification

Date of Expiration



Institute of Geophysical and Geochemical Exploration

(Langfang China)



The series of five CRMs of human hair (GBW07601) and vegetable (GBW07602~GBW07605) is mainly used in regional environment geochemistry and exploration geochemistry as well as agriculture, forestry and medicine for carrying out chemical analysis as calibration samples and samples for monitoring the quality of measurements.

1. Sample collection and preparation

The description of the sample collecting is listed as follows. GBW07602: A bush twigs and leaves was prepared as a composite sample from the district of Dachaidan, Qinghai Province. GBW07603: A bush twigs and leaves was prepared as a composite sample from lead-zinc mining area in Xitieshan, Qinghai Province. GBW07604: A poplar leaves sample was collected from Beijing and Langfang, Hebei Province. GBW07605: A tea sample was collected from Wuyuan, Jiangxi Province. GBW07601: A human hair sample was collected from Langfang, Hebei Province.

The samples were dried in air and coarsely crushed, then they were sterilized at 80°C for 24 hours. A high-alumina porcelain ball mill was used to grind the samples. The sizes of five samples were prepared as follows. GBW07602, GBW07603: All the samples were passed through 80-mesh. GBW07604: 99.6% of the sample was passed through 80-mesh, GBW07605: 99.9% and GBW07601: 99%. The samples were packed and sealed by wax, then irradiated with ^{60}Co to kill the bacteria.

2. Test of homogeneity and stability

For the test of homogeneity ten representative elements of different concentrations were analysed by XRF. The calculation of F from the variance test of analytical results and relative standard deviation indicated that the samples are homogeneous. The minimum sampling weight for analysis is 0.5g. Observations for a stability test of As, Hg, Sb, Cu and Zn were undertaken over 1 year. No significant statistical variations were observed, therefore the samples can be considered to be stable.

3. sample analysis

A multi-laboratory collaborative analysis scheme was adopted in the certification procedure. Twenty-one institutes and laboratories analysed these samples. Sixteen analytical methods based on different principles of measurement were adopted. The main analytical methods that provided data for each element are listed in Table1.

4. Certified values and uncertainty

The certified values should meet the following requirements. The number of laboratory average data contributing to the statistical analysis was not less than six sets. Two or more reliable analytical methods without obvious bias based on different principles were used. The analytical data were obtained from laboratories that could provide good precision. The standard deviation from the laboratory average data was taken as the estimated value of uncertainty.

Any values that did not satisfy the above conditions were assigned proposed values, indicated with parentheses in Table 2, provided not less than four laboratory method average data sets were available.

The certified values of the five CRMs are given in Table2.

5. Package and storage

The sample packages are 10g/bottle or 20g/bottle for human hair, 35g/bottle for vegetable. It is recommended to seal the bottle cap after using and store samples in a desiccator at a shady and cool place.

Table 1. Analytical methods used for the certification of the elements

Element	N*	Analytical methods and the number of the data sets	Element	N*	Analytical methods and the number of the data sets
Ag	7	AAN5 ICP-MS1 INAA1	Mn	16	AA4 ICP7 ICP-MS1 INAA2 XRF2
Al	6	COL3 ICP1 INAA1 XRF1	Mo	8	AA1 COL1 ICP-MS1 POL5
As	9	AF4 ICP-MS1 INAA4	N	8	COL2 VOL6
Au	1	AAN1	Na	12	AA2 IC1 ICP3 INAA5 XRF1
B	7	COL3 ES1 ICP2 ICP-MS1	Nb	1	ICP-MS1
Ba	16	AAN1 ICP8 ICP-MS1 INAA5 XRF1	Nd	6	ICP3 ICP-MS1 INAA2
Be	7	AAN4 ICP2 ICP-MS1	Ni	10	AA2 AAN3 ICP4 ICP-MS1
Bi	6	AF5 ICP-MS1	P	8	COL1 ICP5 XRF2
Br	7	COL1 IC1 INAA4 XRF1	Pb	10	AA2 AAN3 ES1 ICP1 ICP-MS1 POL1 XRF1
Ca	14	AA3 ICP5 INAA4 XRF2	Pr	4	ICP3 ICP-MS1
Cd	8	AAN6 ICP-MS1 POL1	Rb	7	AAN1 ICP-MS1 INAA4 XRF1
Ce	8	AAN6 ICP-MS1 POL1	Re	1	ICP-MS1
Cl	4	COL2 IC1 INAA1	S	9	COL1 IC2 ICP2 VOL3 XRF1
Co	10	AA1 AAN1 ICP2 ICP-MS1 INAA5	Sb	7	AF3 INAA4
Cr	8	AA2 ICP-MS1 INAA5	Sc	10	ICP4 ICP-MS1 INAA5
Cs	6	ICP-MS1 INAA5	Se	6	AF4 COL1 INAA1
Cu	13	AA4 ES1 ICP6 ICP-MS1 XRF1	Si	6	COL4 GR1 XRF1
Dy	4	ICP3 ICP-MS1	Sm	9	ICP3 ICP-MS1 INAA5
Er	3	ICP2 ICP-MS1	Sn	4	ES1 ICP-MS1 POL2
Eu	8	ICP3 ICP-MS1 INAA4	Sr	12	AA1 ICP4 ICP-MS1 INAA4 XRF2
F	6	COL1 ISE5	Ta	2	INAA2
Fe	12	AA3 ICP4 INAA4 XRF1	Tb	5	ICP1 ICP-MS1 INAA3
Ga	3	AAN2 ICP-MS1	Th	6	ICP-MS1 INAA5
Gd	4	ICP3 ICP-MS1	Ti	8	AA1 COL1 ICP5 XRF1
Ge	1	ICP-MS1	Tl	1	ICP-MS1
Hf	5	INAA5	Tm	3	ICP2 ICP-MS1
Hg	6	AA2 AF4	U	4	ICP-MS1 INAA1 LF1 DNA1
Ho	4	ICP3 ICP-MS1	V	8	ICP3 ICP-MS1 INAA2 POL1 XRF1
K	14	AA2 IC1 ICP4 INAA5 XRF2	W	4	COL1 POL3
La	9	ICP4 ICP-MS1 INAA4	Y	6	ICP5 ICP-MS1
Li	7	AA1 AAN1 FP1 ICP3 ICP-MS1	Yb	8	ICP3 ICP-MS1 INAA4
Lu	4	ICP-MS1 INAA3	Zn	18	AA4 ICP7 ICP-MS1 INAA4 XRF2
Mg	10	AA3 ICP5 XRF2	Zr	1	ICP-MS1

Note

N The number of the data sets

* According to the statistics of the sample with the maximum number of the data sets

AA: Atomic absorption spectrometry

AAN: Non-flame atomic absorption spectrometry

AF: Atomic fluorescence spectrometry

COL: Colorimetry

DNA: Delay neutron assay

ES: Emission spectrography

FP: Flame photometry

GR: Gravimetry

IC: Ion chromatography

ICP: Inductively coupled plasma spectrometry

ICP-MS: ICP mass spectrometry

INAA: Instrument neutron activation Analysis

ISE: Ion selective electrode

LF: Laser fluorescence

POL: Polarography

VOL: Volumetry

XRF: X-Ray fluorescence spectrometry

Table 2. Certified values of vegetable and human hair CRMs

Element	GBW07602 (GSV-1)	GBW07603 (GSV-2)	GBW07604 (GSV-3)	GBW07605 (GSV-4)	GBW07601 (GSH-1)
Ag	0.027±0.006	0.049±0.007	(0.013)	(0.018)	0.029±0.008
Al %	0.214±0.022	0.20±0.03	0.104±0.006	(0.30)	
As	0.95±0.12	1.25±0.15	0.37±0.09	0.28±0.04	0.28±0.05
Au ng/g					(2.5)
B	34±7	38±6	53±5	15±4	(1.3)
Ba	19±3	18±2	26±4	58±6	17±2
Be	0.056±0.014	0.051±0.004	0.021 ±0.005	0.034±0.006	0.063±0.020
Bi	(0.022)	0.023±0.005	0.027±0.002	0.063±0.008	0.34±0.02
Br	2.4±0.4	3.0±0.4	7.2±1.4	3.4±0.5	(0.36)
Ca %	2.22±0.13	1.68±0.11	1.81±0.13	0.43±0.04	0.29±0.03
Cd	0.14±0.06	(0.38)	0.32±0.07	0.057±0.010	0.11±0.03
Ce	2.4±0.3	2.2±0.1	0.49±0.07	1.0±0.2	0.12±0.03
Cl %	(1.13)	(1.92)	(0.23)		
Co	0.39±0.05	0.41±0.05	0.42±0.03	0.18±0.02	0.071±0.012
Cr	2.3±0.3	2.6±0.2	0.55±0.07	0.80±0.03	0.37±0.06
Cs	0.27±0.03	0.27±0.02	0.053±0.003	0.29±0.02	
Cu	5.2±0.5	6.6±0.8	9.3±1.0	17.3±1.8	10.6±1.2
Dy		(0.13)	(0.036)	(0.074)	(0.017)
Eu	0.037±0.002	0.039±0.003	0.009±0.003	0.018±0.002	(0.006)
F	24±3	23±4	22±4	320±31	
Fe	1020±67	1070±57	274±17	264±15	54±10
Gd		(0.19)	(0.043)	(0.093)	
Hf	0.14±0.02	(0.15)	(0.026)	(0.033)	
Hg			0.026±0.003	(0.013)	0.36±0.08
Ho		(0.033)		(0.019)	
K %	0.85±0.05	0.92±0.10	1.38±0.07	1.66±0.12	(0.002)
La	1.23±0.10	1.25±0.06	0.26±0.02	0.60±0.04	0.049±0.011
Li	2.4±0.4	2.6±0.4	0.84±0.15	(0.36)	2.0±0.1
Lu		(0.011)		(0.007)	
Mg %	0.287±0.018	0.48±0.04	0.65±0.05	0.17±0.02	0.036±0.004
Mn	58±6	61±5	45±4	1240±70	6.3±0.8
Mo	0.26±0.04	0.28±0.05	0.18±0.01	0.038±0.007	0.073±0.014
N %	1.20±0.02	1.50±0.03	2.56±0.06	3.32±0.09	14.9±0.1
Na	1.10±0.10%	1.96±0.18%	200±13	44±6	152±17
Nd	(1.1)	1.0±0.1	(0.22)	(0.44)	
Ni	1.7±0.4	1.7±0.3	1.9±0.3	4.6±0.5	0.83±0.19
P	830±40	1000±40	1680±60	2840±90	170±10
Pb	7.1±1.1	47±3	1.5±0.3	4.4±0.3	8.8±1.1
Pr		(0.24)		(0.12)	
Rb	4.2±0.2	4.5±0.6	7.6±0.8	74±5	
S %	0.32±0.03	0.73±0.06	0.35±0.04	0.245±0.022	4.3±0.3
Sb	0.078±0.020	0.095±0.014	0.045±0.006	0.056±0.006	0.095±0.016
Sc	0.31±0.03	0.32±0.04	0.069±0.007	0.085±0.013	0.008±0.001
Se	0.184±0.013	0.12±0.02	0.14±0.02	(0.072)	0.60±0.04
Si %	0.58±0.04	0.60±0.07	0.71±0.08	(0.21)	0.087±0.008
Sm	0.19±0.01	0.19±0.02	0.038±0.006	0.085±0.023	(0.012)
Sn		(0.27)			
Sr	345±11	246±16	154±9	15.2±0.7	24±1
Tb	(0.026)	0.025±0.003		(0.011)	
Th	0.37±0.02	0.36±0.04	0.070±0.010	0.061±0.009	
Ti	95±18	95±20	20.4±2.2	24±4	2.7±0.6
U	(0.11)	(0.12)	(0.028)		
V	2.4±0.3	2.4±0.4	(0.64)	(0.86)	
W	(0.06)	(0.06)			
Y	(0.63)	0.68±0.02	0.145±0.015	0.36±0.04	0.084±0.020
Yb	0.063±0.014	0.063±0.009	0.018±0.004	0.044±0.005	
Zn	20.6±2.2	55±4	37±3	26.3±2.0	190±9

Note: Data behind “±” are standard deviations. Data enclosed in brackets are proposed values.