



## Certificate of Certified Reference Materials

NCS DC 73041 — NCS DC 73050

Steam Sediments

Issued in 2018

Approved by China National Analysis Center for Iron and Steel

( Beijing China)

Certified values and uncertainty

ug/g	NCS DC73041	NCS DC73042	NCS DC73043	NCS DC73044	NCS DC73045
Ag**	40±4	55±4	66±5	102±6	856±56
As	1.7±0.2	21.6±1.3	32.2±2.0	11.0±0.6	48.4±2.8
B	(3)	11.2±1.0	55.4±3.9	17.8±1.1	65.5±5.3
Ba	704±20	530±19	460±16	565±19	0.135±0.006*
Be	2.3±0.1	1.5±0.1	2.6±0.2	1.9±0.1	1.4±0.1
Bi	0.11±0.02	0.61±0.05	0.42±0.03	0.32±0.02	0.26±0.02
Br	(0.8)		(1.3)	(0.9)	
Cd	0.029±0.004	0.093±0.008	0.22±0.02	0.36±0.03	(32)
Ce	32±4	40±2	80±5	50±2	50±3
Cl	24±3	87±7	26±3	476±22	99±7
Co	2.7±0.3	7.3±0.5	12.9±0.7	17.1±0.8	9.0±0.6
Cr	(3.7)	11.5±2.0	66±8	29.8±2.6	43.3±2.4
Cs	1.7±0.1	4.5±0.2	16.0±0.8	5.3±0.3	7.6±0.4
Cu	2.8±0.4	10.6±0.7	21±1	916±69	23.8±2.5
Dy	1.2±0.1	2.7±0.2	4.8±0.5	4.0±0.3	3.1±0.2
Er	0.67±0.07	1.58±0.13	2.57±0.25	2.27±0.17	1.76±0.13
Eu	0.68±0.07	0.83±0.06	1.17±0.09	1.06±0.08	0.88±0.08
F	172±19	323±23	632±42	415±27	438±29
Ga	16.3±0.6	12.3±0.6	18.8±0.6	15.1±0.6	10.8 <sup>▲</sup> 10.4~14.3
Gd	1.70±0.15	2.85±0.19	5.43±0.39	4.10±0.29	3.43±0.22
Ge	0.94±0.06	1.23±0.08	1.42±0.09	1.20±0.07	1.31±0.09
Hf	2.75±0.12	2.99±0.25	5.30±0.26	4.61±0.19	5.98±0.24
Hg**	4.7±1.0	11 <sup>▲</sup> 10~13	18.3±1.2	10.0±1.1	111±6
Ho	0.24±0.02	0.53±0.04	0.90±0.10	0.80±0.06	0.61±0.05
I	(0.21)	(0.16)	0.48±0.08	(0.25)	0.34±0.07

Continue...

ug/g	NCS DC73041	NCS DC73042	NCS DC73043	NCS DC73044	NCS DC73045
In	0.020±0.003	0.094±0.006	0.063±0.005	0.051±0.004	0.036±0.003
La	17.0±1.5	23.2±1.1	40.4±2.7	25.0±1.4	25.3±1.9
Li	8.4±0.4	12.8±0.7	38.0±1.4	22.8±1.3	47.2±2.9
Lu	0.12±0.02	0.26±0.03	0.35±0.05	0.34±0.03	0.28±0.03
Mn	322±14	827±38	519±18	960±24	691±14
Mo	0.42±0.04	1.06±0.05	0.55±0.04	3.91±0.23	2.75±0.15
N	(130)	(114)	689±36	(135)	420±26
Nb	6.2±0.5	9.3±0.6	14.6±0.8	10.7±0.6	9.7±0.7
Nd	13.3±1.2	16.9±1.2	33.5±2.3	22.2±1.5	21.5±1.5
Ni	2.3±0.3	5.8±0.6	36.5±1.3	15.2±0.9	21.8±1.3
P	332±14	415±15	498±23	499±15	356±15
Pb	20.5±1.3	10.2±0.7	35.0±1.4	22.0±0.6	0.269±0.013*
Pr	3.68±0.33	4.66±0.33	9.24±0.63	5.93±0.37	5.86±0.39
Rb	75.3±5.3	99.8±3.2	154±3	95.7±5.2	79.0±4.3
S	(61)	(72)	122±10	0.106±0.006*	0.552±0.017*
Sb	0.13±0.03	0.59±0.04	2.52±0.17	0.98±0.07	1.22±0.07
Sc	1.99±0.18	9.02±0.44	12.7±0.6	10.8±0.5	6.87±0.44
Se	0.038±0.007	0.045±0.006	0.146±0.014	0.197±0.022	
Sm	2.14±0.19	3.16±0.22	6.25±0.43	4.38±0.28	3.92±0.25
Sn	1.21±0.15	1.98±0.16	3.46±0.28	2.62±0.19	2.01±0.15
Sr	413±28	243±4	78.0±4.1	277±8	0.343±0.016*
Ta	0.48±0.06	0.67±0.06	1.18±0.07	0.85±0.07	0.78±0.06
Tb	0.25±0.03	0.48±0.04	0.86±0.07	0.68±0.05	0.56±0.04
Te	(0.016)	0.037±0.008	0.040±0.006	(0.054)	0.032±0.006
Th	6.30±0.50	5.84±0.25	16.6±1.1	9.43±0.59	8.39±0.47
Ti*	0.128±0.009	0.248±0.012	0.368±0.015	0.301±0.012	0.265±0.015
Tl	0.47±0.03	0.53±0.03	0.90±0.07	0.72±0.05	6.18±0.33
Tm	0.11±0.02	0.26±0.03	0.37±0.05	0.36±0.03	0.28±0.03
U	1.11±0.14	1.67±0.07	1.71±0.18	2.08±0.10	2.09±0.13

Continue...

ug/g	NCS DC73041	NCS DC73042	NCS DC73043	NCS DC73044	NCS DC73045
V	19.8 <sup>▲</sup> 16.8~20.6	80.0±3.9	88.9±3.2	72.1±3.5	62.3±3.0
W	0.28±0.06	4.37±0.47	2.18±0.15	2.48±0.15	1.19±0.08
Y	8.14±0.84	15.7±0.7	26.6±1.2	22.5±1.1	16.8 <sup>▲</sup> 16.1~19.5
Yb	0.69±0.05	1.66±0.13	2.49±0.27	2.22±0.17	1.80±0.16
Zn	25.0±1.3	40.6±2.0	101±3	83.4±4.5	0.260±0.010*
Zr	87.6±3.5	107±5	180±4	160±5	223±16
SiO <sub>2</sub> *	72.20±0.30	71.14±0.27	63.48±0.43	68.62±0.55	69.66±0.60
Al <sub>2</sub> O <sub>3</sub> *	14.86±0.67	12.85±0.36	14.10±0.40	13.31 <sup>▲</sup> 13.21~13.38	8.84±0.23
TFe <sub>2</sub> O <sub>3</sub> *	1.46±0.06	3.86±0.13	5.16±0.11	4.24±0.13	3.52±0.07
MgO*	0.22±0.02	1.07±0.04	1.73±0.07	1.41±0.05	1.25±0.06
CaO*	1.35±0.05	3.52±0.09	3.78±0.07	2.94±0.10	5.07±0.19
Na <sub>2</sub> O*	4.99±0.15	2.13±0.08	0.83±0.04	2.48±0.09	0.58±0.03
K <sub>2</sub> O*	3.22±0.11	3.24±0.10	3.04±0.11	2.48±0.10	1.85±0.08
FeO*	0.27±0.03	1.23±0.07	2.35±0.11	1.34±0.07	0.82±0.06
H <sub>2</sub> O <sup>+</sup> *	0.80±0.06	1.27±0.07	3.48±0.18	2.17±0.14	(2.7)
CO <sub>2</sub> *			3.02±0.22	(0.9)	(3.9)
Corg*	(0.09)	(0.10)	0.57±0.03	(0.14)	0.46±0.03
TC*	(0.12)	(0.10)	1.33±0.06	0.34±0.03	1.30±0.06
LOI*	(0.98)	1.37±0.07	6.84±0.29	3.23±0.16	7.16±0.34

Note: Data behind "±" are uncertainty;  $U=ku_{CRM}$ ;  $u_{CRM} = \sqrt{u_{char}^2 + u_{bb}^2 + u_{ls}^2 + u_{sts}^2}$ ;  $u_{char} = s/\sqrt{n}$

$U_{CRM}$  combined uncertainty;  $U_{bb}$  between bottle uncertainty;  
 $U_{ls}$  long time stability uncertainty, neglectable;  
 $U_{sts}$  short time stability uncertainty, neglectable;  
 $U_{char}$  standard uncertainty of analysis;  
s standard deviation;  
n number of data;  
k cover factor;  
k=2 with confidence interval at 95%.

Data enclosed in brackets are reference values.

Data with <sup>▲</sup> is middle value, the data under it is confidence range.

Data with \* is mean in percent, with \*\* is in ng/g.

Certified values and uncertainty

ug/g	NCS DC73046	NCS DC73047	NCS DC73048	NCS DC73049	NCS DC73050
Ag**	83±10	90±5	67±5	89±5	149±10
As	3.5±0.3	14.8±0.6	24.9±0.8	33.9±1.1	3.5±0.3
B	8.2±1.2	61.9±4.3	74.5±5.0	80.1±5.3	10.4±1.0
Ba	311±7	337±10	318±15	456±11	926±45
Be	1.8±0.2	2.0±0.2	1.6±0.1	6.4±0.6	4.6±0.2
Bi	0.06±0.01	0.41±0.03	0.30±0.04	3.98±0.21	1.06±0.08
Br		6.3±0.8	1.6±0.3	6.4±0.7	3.7±0.5
Cd	(0.2)	4.3±0.3	0.23±0.02	0.38±0.04	0.60±0.04
Ce	98±5	79±7	59±4	85±6	138±13
Cl	32±5	36±6	41±6	56±8	55±6
Co	57.9±2.2	19.6±1.2	11.3±0.6	12.8±0.8	12.7±0.9
Cr	0.109±0.009*	144±9	43.1±3.8	70.0±6.7	36.5±3.6
Cs	1.3±0.1	7.2±0.6	5.7±0.2	21.4±1.1	6.5±0.6
Cu	186±11	39.9±2.3	14.6±0.8	25.7±1.3	22.3±1.2
Dy	6.6±0.6	4.6±0.3	3.7±0.4	8.6±0.6	9.7±0.7
Er	3.25±0.31	2.64±0.19	2.14±0.19	4.74±0.49	5.52±0.39
Eu	2.77±0.21	1.00±0.07	0.85±0.06	0.84±0.06	1.72±0.12
F	558±36	856±59	581±37	663±45	616±43
Ga	20.6±0.7	15.0±0.6	10.7±0.5	17.4±0.7	28.4±1.5
Gd	7.99±0.55	4.59±0.31	3.92±0.26	7.69±0.62	9.85±0.68
Ge	1.38±0.12	1.34±0.07	1.17±0.08	1.42±0.09	1.79±0.10
Hf	6.69±0.35	7.09±0.32	7.35±0.27	10.5±0.6	12.4±0.9
Hg**	12.2±1.3	148±11	86.2±5.5	266±24	63.1±3.5
Ho	1.21±0.12	0.91±0.07	0.72±0.08	1.58±0.19	1.88±0.14
I	0.31±0.05	4.31±0.53	1.36±0.16	3.95±0.48	2.95±0.36
In	0.086±0.008	0.060±0.004	0.039±0.002	0.093±0.008	0.130±0.009

Continue...

ug/g	NCS DC73046	NCS DC73047	NCS DC73048	NCS DC73049	NCS DC73050
La	49.8±2.0	34.2±1.8	29.5±2.1	40.0±2.8	71.8±5.8
Li	14.7±0.6	41.2±1.5	19.9±0.7	92.9±3.0	43.6±2.1
Lu	0.40±0.05	0.42±0.04	0.34±0.03	0.86±0.09	0.84±0.07
Mn	0.141±0.007*	0.111±0.004*	486±24	638±31	0.144±0.007*
Mo	0.67±0.08	10.0±0.4	0.68±0.05	4.88±0.21	2.59±0.15
N	<sup>229</sup> ▲ 222~283	0.247±0.011*	318±24	0.136±0.007*	0.142±0.008*
Nb	35.3±2.0	17.2±0.7	12.1±0.7	18.4±1.2	35.3±2.6
Nd	47.8±3.2	28.3±1.9	24.5±1.7	38.5±2.5	56.8±3.8
Ni	349±17	60.4±2.7	19.2±0.9	28.1±1.7	16.0±0.7
P	0.118±0.005*	620±23	224±13	410±20	787±39
Pb	(12)	29.0±1.0	24.7±1.1	35.7±1.3	85.0±3.9
Pr	12.2±0.81	7.70±0.49	6.69±0.44	10.3±0.7	15.8±1.1
Rb	30.0±2.4	84.0±4.9	82.2±2.8	204±11	264±18
S	(69)	363±19	84±10	207±8	229±15
Sb	0.22±0.04	1.90±0.11	2.27±0.15	1.18±0.09	0.31±0.04
Sc	29.5±0.9	11.1±0.7	7.10±0.40	11.4±0.8	12.0±1.0
Se	0.089±0.010	8.75±0.95	0.159±0.016	0.652±0.066	0.261±0.028
Sm	8.97±0.62	5.17±0.34	4.45±0.30	8.65±0.59	10.8±0.8
Sn	2.42±0.18	3.08±0.29	2.41±0.19	9.39±0.85	5.19±0.41
Sr	363±15	84.3±2.6	17.9±1.8	19.3±2.0	138±4
Ta	2.40±0.15	1.25±0.09	0.96±0.11	4.55±0.37	3.18±0.20
Tb	1.23±0.09	0.76±0.06	0.65±0.05	1.35±0.13	1.63±0.11
Te	(0.03)	0.059±0.013	0.030±0.006	0.046±0.008	0.076±0.016
Th	4.96±0.10	12.0±0.6	9.81±0.51	25.9±1.4	27.5±1.8
Ti*	1.71±0.06	0.452±0.017	0.308±0.010	0.313±0.011	0.461±0.011
Tl	~0.15	0.87±0.06	0.52±0.03	1.33±0.13	1.55±0.15
Tm	0.45±0.05	0.42±0.03	0.35±0.03	0.87±0.07	0.87±0.07
U	1.24±0.07	5.91±0.22	2.34±0.11	8.79±0.41	5.99±0.26

Continue...

ug/g	NCS DC73046	NCS DC73047	NCS DC73048	NCS DC73049	NCS DC73050
V	332±10	302±11	60.1±3.5	91.8±3.2	74.1±3.1
W	(0.5)	1.92±0.15	2.15±0.16	18.9±1.5	4.73±0.27
Y	27.9±1.6	26.4±1.3	21.8±0.6	48.3±2.9	52.8±5.6
Yb	2.66±0.24	2.72±0.19	2.23±0.17	5.80±0.45	5.57±0.39
Zn	115±7	94.2±2.9	51.7±2.2	85.2±3.2	189±9
Zr	252±12	264±5	275±9	346±13	449±14
SiO2*	47.27±0.22	70.49±0.61	82.85±0.43	73.54±0.44	59.79±0.23
Al <sub>2</sub> O <sub>3</sub> *	10.84±0.26	10.83±0.14	7.90±0.27	11.40±0.41	18.85±0.69
TFe <sub>2</sub> O <sub>3</sub> *	12.91±0.36	4.64±0.11	3.05±0.09	4.08±0.11	5.26±0.18
MgO*	8.82±0.31	1.03±0.04	0.67±0.03	0.96±0.05	0.83±0.06
CaO*	7.42±0.20	1.14±0.05	(0.13)	0.21±0.02	0.60±0.03
Na <sub>2</sub> O*	1.62 <sup>▲</sup> 1.38~1.66	0.37±0.03	(0.08)	0.36±0.03	0.96±0.03
K <sub>2</sub> O*	1.12±0.05	1.49±0.07	2.07±0.06	2.27±0.09	3.94±0.22
FeO*	2.20±0.11	1.57±0.10	(0.33)	1.65±0.09	(1.5)
H <sub>2</sub> O+*	(5.6)	4.53±0.27	2.15±0.11	3.90±0.22	6.04±0.29
CO <sub>2</sub> *		(0.3)			
Corg*	0.30±0.02	2.21±0.10	(0.17)	1.39±0.06	1.47±0.07
TC*	0.34±0.02	2.41±0.12	(0.21)	1.45±0.07	1.50±0.08
LOI*	5.87±0.39	8.52±0.43	2.34±0.13	6.26±0.29	8.35±0.43

Note: Data behind "±" are uncertainty;  $U=ku_{CRM}$ ;  $u_{CRM} = \sqrt{u_{char}^2 + u_{bb}^2 + u_{ls}^2 + u_{sts}^2}$ ;  $u_{char} = s/\sqrt{n}$

$U_{CRM}$  combined uncertainty;  $U_{bb}$  between bottle uncertainty;  
 $U_{ls}$  long time stability uncertainty, neglectable;  
 $U_{sts}$  short time stability uncertainty, neglectable;  
 $U_{char}$  standard uncertainty of analysis;  
s standard deviation;  
n number of data;  
k cover factor;  
k=2 with confidence interval at 95%.

Data enclosed in brackets are reference values. Date with ~ is information value.

Data with <sup>▲</sup> is middle value, the data under it is confidence range.

Data with \* is mean in percent, with \*\* is in ng/g.

The certification will expire in Dec.2027. although we reserve the right to make change as issue revisions.

The sample is packed in glass bottle with size less 0.074 mm over 99%. The minimum package is 70 g.

The minimum weight for analysis is 0.1g.

## Analytical Methods

Methods	Elements	Methods	Elements
ICP-MS	Ag,As,Ba,Be,Bi,Cd,Co,Cr,Cs,Cu,Ga,Ge,Hf,I, In,Li,Mn,Mo,Nb,Ni,Pb,Rb,Sb,Sc,Sn,Sr,Ta,Te,T h,Ti,Tl,U,V,W,Zr, Re	IC	Br,Cl
XRF	As,Ba,Br,Cl,Co,Cr,Cu,Ga,Hf,Mn,Nb,Ni,P,Pb,R b,S,Sc,Sr,Th,Ti,V,Y,Zn,Zr and main content	AAN	Cd,Tl
ICP-AES	B,Ba,Be,Co,Cr,Cu,Li,Mn,Ni,P,Pb,Sc,Sr,Ti,V,Zn ,Al,Fe <sup>3+</sup> ,Mg,Ca,Na,K	ES	Ag,B,Sn
AFS	As,Bi,Ge,Hg,Sb,Se,Te	POL	Mo,W
AAS	Mn,Mg,Ca,Na,K	COL	I,P,Ti,Fe <sup>3+</sup>
VOL	Si, Al,Fe <sup>3+</sup> ,Fe <sup>2+</sup> Mg,Ca,C,S	GR	Si, H <sub>2</sub> O <sup>+</sup> , LOI

Note:

ICP-MS: Inductively Coupled Plasma Mass Spectrometry

ICP-AES: Inductively Coupled Plasma Atomic Emmission Spectrometry

AAS: Flame Atomic Absorption spectrometry

AAN: Non-flame Atomic Absorption spectrometry

XRF: X-Ray Fluorescence spectrometry

AFS: Atomic Fluorescence spectrophotometry

VOL: Volumetry

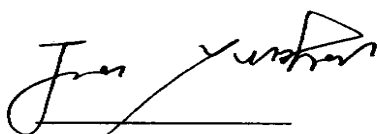
IC: Ion Chromatography

COL: Colorimetry

POL: Polarography

ES: Emission Spectrography

GR: Gravimetry



**Jia Yunhai**

**Laboratory Director**