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La-Ce isotope measurements by Multicollector-ICPMS

Electronic Supplementary Information

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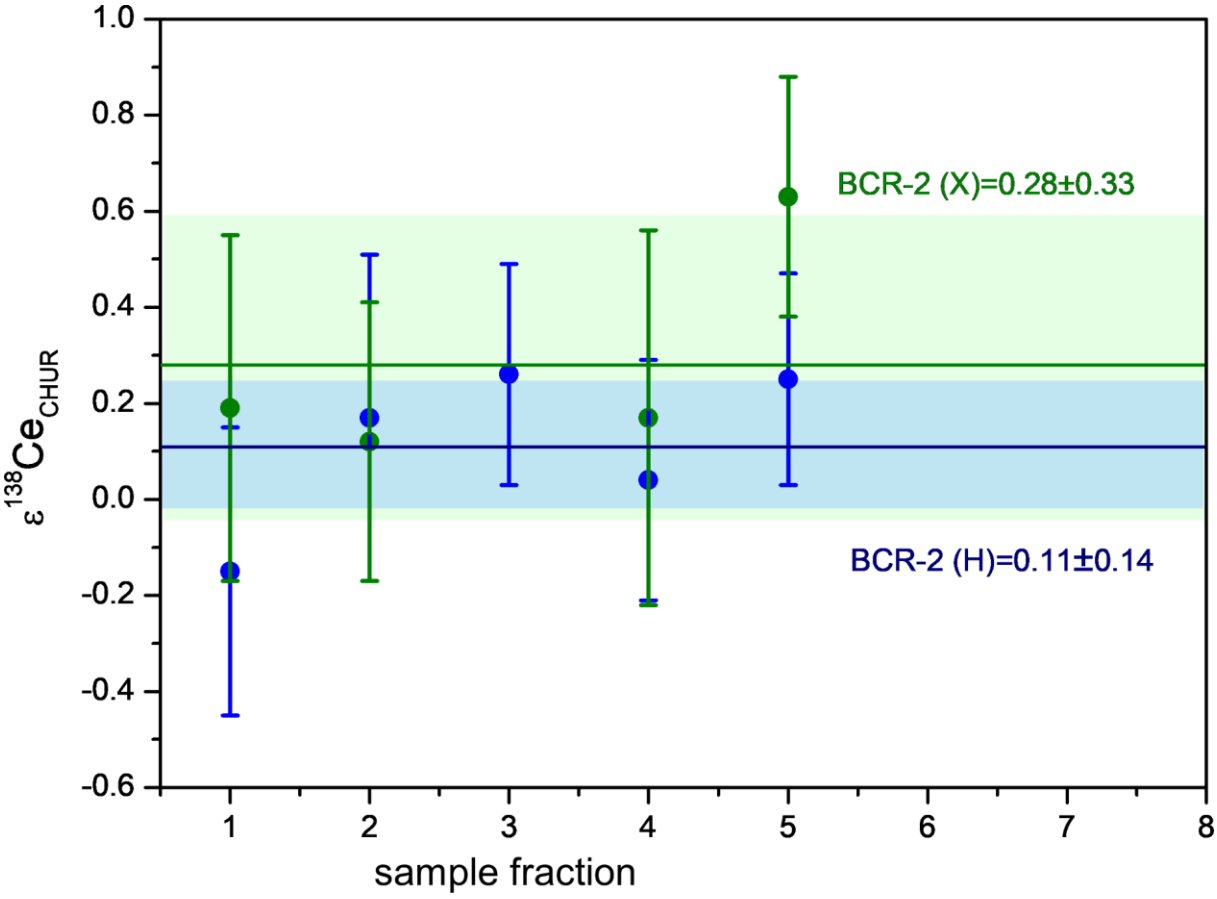

ESI Figure 1 Cerium isotope ratios obtained for rock standard BCR-2. The results are expressed in $\varepsilon^{138}Ce$ relative to CHUR (Bellot et al[3]). The mean value for the 5 BCR-2 samples using a standard Ni sample cone and a H-type skimmer cone is analytically indistinguishable from the mean value for the 4 BCR-2 samples using a standard Ni sample cone and a X-type skimmer cone.

ESI Table 1 Typical MC-ICPMS instrument operating conditions during Ce isotope ratio measurements

Operation power [W]	1200
Sample gas flow rate [L/min]	0.9
Auxiliary gas flow rate [L/min]	0.7
Cooling gas flow rate [L/min]	15
Nebulizer	100µL/min MicroFlow PFA
ARIDUS II^{TM} sweep gas flow rate [L/min]	5.6
ARIDUS II^{TM} nitrogen gas flow rate [L/min]	0.06

ESI Table 2 Effects of interfering Ba, Ce and Nd on the accuracy of measured ε^{138}Ce and ε^{142}Ce values. Analyses were performed using a 600 ppb JMC-304 solution doped with variable amounts of the interfering elements Ba, La and Nd.

ratio	ε^{138}Ce	ε^{142}Ce
^{137}Ba/^{140}Ce		
4.22E-06	0.17±0.23	
2.45E-05	0.78±0.31	
1.18E-04	4.20±0.38	
2.33E-04	8.42±0.35	
1.17E-03	41.05±1.11	
^{139}La/^{140}Ce		
2.37E-04	-0.25±0.35	
1.72E-03	-0.28±0.38	
1.91E-02	-0.08±0.39	
9.50E-02	1.22±0.44	
1.96E-01	4.02±0.27	
^{144}Nd/^{140}Ce		
5.00E-06		-0.19±0.17
2.48E-05		-0.12±0.14
2.54E-04		-0.23±0.17
6.18E-03		-1.37±0.19
1.34E-02		-2.57±0.19
2.60E-02		-4.93±0.25
5.18E-02		-9.65±0.20

*ESI Table 3 Results for long term Ce isotope measurements of (i) Cologne-AMES and (ii) Mainz-AMES. The weighted means of $\varepsilon^{138}Ce$ are +0.83±11ppm for Cologne-AMES and +2.61±9ppm for Mainz-AMES (all 2 r.s.d). *measurement session, where data were collected using an X-skimmer cone instead of an H-type skimmer cone.*

Standard	number of measurements	Session	$\varepsilon^{138}Ce$ (JMC-304)	2 r.s.e [ppm]
***Cologne*-AMES**	3	Session 1	0.67	0.16
	3	Session 2	0.89	0.04
	3	Session 3	0.98*	0.04
	2	Session 4	0.76	0.03
	2	Session 5	1.11	0.13
	4	Session 6	0.99	0.28
	11	Session 7	0.76	0.11
	15	Session 8	0.54	0.09
	15	Session 9	0.67	0.07
	15	Session 10	0.77	0.08
***Mainz*-AMES**	3	Session 1	2.66	0.12
	3	Session 2	2.57	0.04
	3	Session 3	2.67*	0.15
	2	Session 4	2.54	0.07
	3	Session 5	2.83	0.29
	3	Session 6	2.61	0.18
	11	Session 7	2.46	0.14

ESI Table 4 Results of repeated measurements of the absolute $^{138}Ce/^{136}Ce$ ratio of the Mainz-AMES standard. In our study, the $^{138}Ce/^{136}Ce$ ratios were measured using $^{136}Ce/^{140}Ce$ 0.002124072[21,36] or $^{136}Ce/^{142}Ce$=0.01688[36] as normalization ratio.

number of measurements	$^{138}Ce/^{136}Ce$ rel $^{136}Ce/^{140}Ce$	2 rsd [abs]	$^{138}Ce/^{136}Ce$ rel $^{136}Ce/^{142}Ce$	2 rsd [abs]
2	1.33732	0.00001	1.33731	0.00001
3	1.33741	0.00001	1.33759	0.00009
18	1.33736	0.00002	1.33726	0.00004
3	1.33755	0.00001	1.33767	0.00009
3	1.33759	0.00001	1.33761	0.00005
3	1.33746	0.00003	1.33746	0.00006
2	1.33759	0.00001	1.33761	0.00005
3	1.33755	0.00004	1.33736	0.00005
3	1.33749	0.00002	1.33730	0.00005
11	1.33747	0.00002	1.33730	0.00001
mean±2rse	**1.33748±0.0003**		**1.33745±0.0004**	

*ESI Table 5: Cerium isotope results for different interface cone combinations used during MC-ICPMS measurements. *The sample BCR-2 Batch 1 was measured 4 times in one analytical session to investigate the reproducibility of X cone combinations. Reported uncertainties correspond to 2 s.e.*

Sample	ε^{138}Ce(CHUR) H	2 s.e	ε^{138}Ce(CHUR) X	2 s.e	ε^{138}Ce(CHUR) J	2 s.e	ε^{138}Ce(CHUR) X/J	2 s.e
JG-1 Batch 1	0.06	0.21	0.19	0.22				
JA-2 Batch 1	-0.24	0.21			-0.40	0.22		
BCR-2 Batch 1	-0.07	0.26	0.09	0.20	-0.26*	0.20		
BCR-2 Batch 2	-0.22	0.22			-0.11	0.24	-0.29	0.19
BCR-1 Batch 1	-0.17	0.24	-0.41	0.30	-0.34	0.20		
BCR-1 Batch 2	-0.16	0.26					-0.54	0.20
JB-1b Batch 1	-0.78	0.21			-0.93	0.23		
AGV-1 Batch 1	-0.76	0.20	-0.62	0.20	-1.00	0.18		
AGV-1 Batch 2	-0.70	0.20					-0.86	0.19
LP-1 Batch 1	-1.32	0.24	-1.35	0.24	-1.38	0.17		
LP-1 Batch 2	-1.29	0.19					-1.20	0.24
BHVO-2 Batch 1	-1.30	0.22	-1.12	0.30	-1.56	0.22		
BHVO-2 Batch 2	-1.62	0.24					-1.71	0.19
JB-3 Batch 1	-1.57	0.22	-1.38	0.14	-1.57	0.21		
JB-1b Batch 2	-0.50	0.30					-0.56	0.23