High Intermediate precision Sm Isotope Measurements in Geological Samples by MC-ICP-MS

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Table S1 Potential isobaric interferences and their abundances (%)

	144	147	148	149	150	152	154
Sm	3.07	14.99	11.24	13.82	7.38	26.75	22.75
Nd	23.79		5.76		5.64		
Gd						0.20	2.18

Table S 2 Instrumental operating parameters for Sm stable isotopes measurements

Instrument parameters	Neptune Plus
RF power	1168W
Cooling gas	16.0 L min^{-1}
Auxiliary gas	0.95 L min^{-1}
Sample gas	0.975 L min^{-1}
Extraction	-2000V
Focus	-726V
Data acquisition (integration×cycle×block)	4.194 s/cycle ×40 cycle×1
Typical ^{149}Sm sensitivity	15 V /mg L^{-1}
Background of ^{149}Sm	less than 0.2mV
Mass resolution	low resolution
Sample uptake	50 µL min^{-1}
Spray chamber	Glass cyclonic
Nebulizer type	Micromist PFA nebulizer
Mass bias correction	Internal correction using $^{153}Eu/^{151}Eu$=1.09160[1]

Cup	L4	L3	L2	L1	C	H1	H2	H3
	^{146}Nd	^{147}Sm	^{149}Sm	^{150}Sm	^{151}Eu	^{152}Sm	^{153}Eu	^{155}Gd

Table S3 Sm stable isotopic ratios of geological reference rocks in this work.

Sample	**Description**	**Sm(μg g^{-1})[a]**	**Run number[b]**	**^{146}Nd/^{149}Sm**	**^{155}Gd/^{149}Sm**	**δ$^{150/149}$Sm(‰)[c]**	**δ$^{152/149}$Sm(‰)[c]**	**Yield(%**
AA-STD	Pure		**Average+2SD**			**0.00±0.04**	**0.00±0.04**	
BHVO-2	Basalt	6.12	BHVO-2-(1)	0.00045	0.00023			99.3
			BHVO-2-(1)*			0.01±0.02	0.02±0.03	
			BHVO-2-(2)	0.00055	0.00051	0.02±0.02	-0.01±0.02	99.6
			BHVO-2-(2)*			0.03±0.01	-0.01±0.02	
			BHVO-2-(3)	0.00070	0.00056	-0.02±0.02	-0.01±0.02	99.5
			BHVO-2-(3)*			-0.04±0.02	-0.02±0.02	
			BHVO-2-(4)	0.00054	0.00037	-0.01±0.02	-0.01±0.03	99.6
			BHVO-2-(4)*			-0.01±0.03	-0.01±0.03	
			BHVO-2-(5)	0.00027	0.00044	-0.03±0.02	-0.02±0.02	99.5
			BHVO-2-(6)	0.00069	0.00024	-0.02±0.02	-0.02±0.02	99.4
			BHVO-2-(6)*			-0.02±0.02	0.02±0.03	
			BHVO-2-(7)	0.00098	0.00057	-0.01±0.02	0.02±0.03	99.3
			BHVO-2-(8)	0.00014	0.00028	-0.03±0.02	-0.02±0.03	99.2
			BHVO-2-(8)*			-0.01±0.02	-0.01±0.03	99.3

			BHVO-2-(9)	0.00080	0.00174	-0.01±0.02	0.03±0.03	99.6
			Average+2SD			**-0.01±0.03**	**0.00±0.04**	
JB-2	Basalt	2.28	JB-2-(1)	0.00048	0.00064	-0.01±0.02	0.01±0.02	99.4
			JB-2-(1)*			-0.02±0.02	-0.01±0.03	
			JB-2-(2)	0.00032	0.00023	0.01±0.02.	-0.02±0.02.	99.6
			JB-2-(2)*			0.00±0.02	0.00±0.02	
			Average+2SD			**0.00±0.03**	**0.00±0.02**	
AGV-2	Andesite	5.75	AGV-2-(1)	0.00052	0.00006	-0.02±0.02	-0.02±0.02	99.5
			AGV-2-(1)*			0.02±0.03	-0.03±0.03	
			AGV-2-(2)	0.00020	0.00002	-0.01±0.02	-0.01±0.03	99.3
			AGV-2-(3)	0.00055	0.00051	-0.01±0.02	-0.01±0.02	99.6
			AGV-2-(4)	0.00103	0.00095	-0.01±0.02	-0.01±0.02	99.5
			AGV-2-(5)	0.00039	0.00016	-0.02±0.02	-0.01±0.02	99.8
			AGV-2-(6)	0.00077	0.00061	-0.01±0.02	0.02±0.02	99.2
			Average+2SD			**-0.01±0.03**	**-0.01±0.03**	
GSR-2	Andesite	3.4	GSR-1-(1)	0.00067	0.00006	-0.02±0.02	-0.06±0.02	99.4
			GSR-1-(1)*			-0.03±0.02	-0.08±0.02	
			GSR-1-(2)	0.00002	0.00005	-0.02±0.02	-0.06±0.02	99.7

			Average+2SD			**-0.02±0.01**	**-0.07±0.03**	
GSP-2	Granodiorite	27	GSP-2-(1)	0.00060	0.00012	0.01±0.02	0.03±0.03	99.8
			GSP-2-(1)*			0.01±0.02	0.03±0.03	
			GSP-2-(2)	0.00057	0.00010	-0.01±0.02	0.02±0.02	99.5
			GSP-2-(2)*			0.02±0.02	0.02±0.02	
			GSP-2-(3)	0.00059	0.00011	0.01±0.02	0.03±0.02	99.6
			GSP-2-(3)*			0.00±0.02	0.03±0.02	
			GSP-2-(4)	0.00079	0.00010	0.03±0.02	-0.02±0.03	99.5
			GSP-2-(4)*			0.01±0.02	-0.01±0.03	
			GSP-2-(5)	0.00047	0.00009	-0.02±0.03	-0.02±0.03	99.6
			Average+2SD			**0.01±0.03**	**0.01±0.04**	
JG-2	Granite	7.75	JG-2-(1)	0.00014	0.00004	0.01±0.02	0.03±0.03	99.5
			JG-2-(1)*			-0.01±0.02	0.04±0.02	
			JG-2-(2)	0.00008	0.00025	0.00±0.02	0.00±0.03	99.2
			Average+2SD			**0.00±0.02**	**0.03±0.04**	
STM-1	Nepheline syenite	12.15	STM-1-(1)	0.00133	0.00047	0.01±0.02	-0.01±0.03	99.6
			STM-1-(1)*			-0.03±0.02	-0.03±0.03	
			STM-1-(2)	0.00077	0.00021	0.02±0.02	0.01±0.03	99.3

			STM-1-(3)	0.00084	0.00111	0.01±0.02	0.01±0.03	99.6
			STM-1-(3)*			0.02±0.03	0.03±0.03	
			Average+2SD			**0.01±0.04**	**0.00±0.05**	
SY-3	Syenite	109	SY-3-(1)	0.00020	0.00010	0.02±0.02	0.00±0.02	99.6
			SY-3-(1)*			0.01±0.02	0.02±0.02	
			SY-3-(2)	0.00040	0.00006	0.00±0.02	0.03±0.02	99.5
			SY-3-(3)	0.00026	0.00008	0.01±0.02	0.03±0.03	99.4
			Average+2SD			**0.00±0.02**	**0.02±0.03**	
Nod-A-1	Manganese nodule	21.05	Nod-A-1-(1)	0.00170	0.00485	0.02±0.03	0.12±0.02	99.6
			Nod-A-1-(1)*			0.02±0.02	0.13±0.02	
			Nod-A-1-(2)	0.00013	0.00010	0.02±0.02	0.08±0.02	99.2
			Nod-A-1-(2)*			0.03±0.02	0.06±0.02	
			Nod-A-1-(2)**			0.06±0.02	0.10±0.02	
			Average+2SD			**0.03±0.03**	**0.10±0.05**	
Nod-P-1	Manganese nodule	29.7	Nod-P-1-(1)	0.00093	0.00723	0.04±0.02	0.09±0.02	99.5
			Nod-P-1-(1)*			0.04±0.03	0.06±0.03	
			Nod-P-1-(2)	0.00017	0.00011	0.02±0.02	0.08±0.02	99.7
			Average+2SD			**0.03±0.03**	**0.08±0.02**	

GSMS-3	Marine	12	GSMS-3-(1)	0.00059	0.00005	0.06±0.03	0.14±0.03	99.5
	Sediments		GSMS-3-(1)*			0.04±0.03	0.17±0.03	
			GSMS-3-(2)	0.00029	0.00055	0.03±0.02	0.15±0.02	99.2
			Average+2SD			**0.04±0.03**	**0.15±0.04**	

a The Sm mass fractions of reference geological materials are taken from http://georem.mpch-mainz.gwdg.de/

b () Numbers in parentheses represent a separate digestion. * represents a duplicate analysis on the same solutions.

c uncertainties on measured $\delta^{150/149}$Sm and $\delta^{152/149}$Sm are 2 standard errors.

d Uncertainties on averages are 2 standard deviations.

The influence of Eu. The influence of Eu was assessed using six Sm–Eu solutions, (i) 120 μg L^{-1} of Sm and 20 μg L^{-1} Eu, (ii) 120 μg L^{-1} of Sm and 30 μg L^{-1} Eu, (iii) 120 μg L^{-1} of Sm and 40 μg L^{-1} Eu, (iv) 120 μg L^{-1} of Sm and 50 μg L^{-1} Eu, (v) 120 μg L^{-1} of Sm and 60 μg L^{-1} Eu, and (vi) 120 μg L^{-1} of Sm and 70 μg L^{-1} Eu. Each solution was analyzed five times. The $\delta^{152/149}$Sm values were −0.01 ‰ ± 0.07 ‰ (2SD, n = 5), −0.01‰ ± 0.06 ‰ (2SD, n = 5), 0.00 ‰ ± 0.04 ‰ (2SD, n = 5), −0.01 ‰ ± 0.03 ‰ (2SD, n = 5), and 0.00 ‰ ± 0.03 ‰ (2SD, n = 5), 0.00 ‰ ± 0.02 ‰ (2SD, n = 5) for (i) to (vi), respectively (Figure S1). Thus, the Sm stable isotope ratios did not deviate from zero regardless of Eu/Sm ratio. Hence, the influence of Eu was ignored, and a solution of 120 μg L^{-1} Sm and 50 μg L^{-1} Eu was selected throughout the experiments.

Figure S1. Repeated analysis of the NIST 3147a standard with six Eu/Sm ratios for $\delta^{152/149}$Sm. The horizontal area represents a 2SD uncertainty of ± 0.04 ‰

1. T. L. Chang, Q. Y. Qian, M. T. Zhao and J. Wang, *International Journal of Mass Spectrometry and Ion Processes*, 1994, **139**, 95-102.