Supporting Information

High-precision determination of Indium isotope by MC-ICP-MS with a two-stage column separation method with extraction resin

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Table S1 GRMs investigated in this study.

GRM	Suppplier[a]	Lithology	Reported In mass fraction (μg/g)	Reported $\delta^{115/113}In_{IPGP}$ (‰)
GSP-2	(USGS)	Granodiorite	0.035[b]-0.069[c]	0.39[c]
BIR-1a	(USGS)	Basalt	0.016[d]-0.076[c]	0.36-0.41[c]
BHVO-2	(USGS)	Basalt	0.023[e]-1.87[d]	0.30-0.34[c]
GBW07105	(IGGE)	Olivine basalt	0.06[f]-0.064[g]	
GBW07405a	(IGGE)	Soil	0.122[h]	
GBW07406a	(IGGE)	Soil		
GBW07315	(NRCG)	Marine sediment		
GBW07295	(NRCG)	polymetallic nodule	120[i]	
GBW(E)070026	(IGGE)	Sulfide		

[a] Source of the reference material. USGS, United States Geological Survey; IGGE, Institute of China Geophysical and Geochemical Exploration; NRCG, National Research Center of Geoanalysis, China.

The GeoReM database (http://georem.mpch-mainz.gwdg.de, last checked on 01.22.2026) proposes working values for the GRMs above.

The In mass fraction of GRMs from the literature: [b] Simons et al., (2017)[21]; [c] Liu et al., (2023)[17]; [d] Zou et al., (2020)[22]; [e]

Table S2 The Separation Processes for In in this study and other purification method for comparison.

Method	Stage	Resin	Step	Purpose	Volume (mL)
This study	First	N235 resin (0.6-0.8 mL, 75 μm)	2 mol/L HNO3	Clean	4
			0.5 mol/L HBr	Condition	4
			0.5 mol/L HBr	Load	6-8
			0.5 mol/L HBr	Mattrix removal	14
			0.2 mol/L HCl	Collect	12
	Second	TOPO resin (0.4-0.5 mL, 50-100 μm)	2 mol/L HNO3	Clean	6
			0.5 mol/L HCl	Condition	3
			0.5 mol/L HCl	Load	13
			0.5 mol/L HCl	Mattrix removal	10
			1 mol/L HCl + 0.8 mol/L HNO3	Collect In	6
Liu *et al*.[17]	First	AG1-X8 (0.4 mL, 100-200 mesh)	1.5 mol/L HBr	Condition	3
			1.5 mol/L HBr	Load	3
			0.1 mol/L HBr	Collect	12
	Second	AG1-X8 (0.4 mL, 100-200 mesh)	1.5 mol/L HBr	Condition	3
			1.5 mol/L HBr	Load	0.5
			1.5 mol/L HBr	Mattrix removal	2.5
			0.1 mol/L HBr	Load	12
	Third	AG1-X8 (0.4 mL, 100-200 mesh)	2 mol/L HCl	Condition	3
			2 mol/L HCl	Load	1
			2 mol/L HCl	Collect	9
	Fourth	AG1-X8 (0.4 mL, 100-200 mesh)	0.1 mol/L HF	Condition	3
			0.1 mol/L HF	Load	1
			0.1 mol/L HF	Collect	9
Zhu *et al*.[18]	Single column	AG-MP-1M (3 mL, 100-200 mesh)	7 mol/L HCl	Condition	10
			7 mol/L HCl	Load	3
			7 mol/L HCl	Mattrix removal	10
			6 mol/L HCl	Collect	16

Table S3 Ratios of some element X relative to In mass fractions after separation of nine geological reference materials.

[X]/[In] (con./con.)

Sample	Mg	Ca	Fe	Zn	Ge	As	Mo	Ru	Cd	Sn	Sb
GSP-2	0.00000	0.00000	0.00000	1.93639	0.00000	0.00576	0.00000	0.00000	0.00051	0.00580	0.00097
BIR-1	0.00000	0.00000	3.99100	4.10956	0.00000	0.00000	0.00280	0.00000	0.00027	0.00596	0.30496
BHVO-2	0.42137	0.00000	0.00000	0.00000	0.00000	0.00000	0.00003	0.00000	0.00000	0.00000	0.00000
GBW07105	0.42246	0.00000	0.00000	0.06316	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
GBW07405a	0.00000	0.00000	0.00000	0.00000	0.00000	0.00134	0.00173	0.00000	0.00034	0.00372	0.20672
GBW07406a	0.00000	0.00000	0.13787	15.74698	0.00000	0.00026	0.00525	0.00000	0.00007	0.00069	0.01084
GBW07315	0.05827	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00005	0.00000	0.00000	0.00000
GBW07295	0.04365	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
GBW07026	0.00000	0.00000	0.00000	2.93770	0.00000	0.00311	0.00000	0.00000	0.00021	0.00038	0.06437

Effectiveness of purification procedures on removing the matrix elements for nine geological reference materials. X denotes a matrix element, and X/In is the concentration ratio of the matrix elements to In. The concentration values of X and In are averaged over the three measurements with a relative standard deviation of <5.00%.

Table S4 In isotopic compositions of geological reference materials from this study and the literature.

Reference material	Lithology	Oringin	In (μg/g)[a]	RSD (%)	$\delta^{115/113}In_{IPGP}$ (‰)	2SD	N	n
GSP-2	Granodiorite	This study	0.042		0.28	0.07	3	3
(USGS)		This study	0.042		0.25	0.07		
		This study	0.043		0.30	0.03		
		Mean	**0.042**	**1.36**	**0.29**	**0.02**		
		Liu *et al*.(2023)[17]	0.069		0.39	0.06		
BIR-1a	Basalt	This study	0.043		0.42	0.08	3	3
(USGS)		This study	0.044		0.45	0.11		
		This study	0.043		0.45	0.08		
		Mean	**0.043**	**1.33**	**0.44**	**0.03**		
		Liu *et al*.(2023)[17]	0.076		0.39	0.07		
BHVO-2	Basalt	This study	0.075		0.22	0.03		
(USGS)		This study	0.074		0.28	0.04		
		This study	0.074		0.22	0.04		
		Mean	**0.074**	**0.78**	**0.24**	**0.07**		
		Liu *et al*.(2023)[17]	0.087		0.32	0.04		
GBW07105	Olivine	This study	0.06		0.41	0.05		
(IGGE)	basalt	This study	0.059		0.36	0.05		
		This study	0.06		0.34	0.04		
		Mean	**0.06**	**0.97**	**0.37**	**0.07**		
GBW07405a	Soil	This study	1.518		0.14	0.05	3	3
（IGGE）		This study	1.515		0.17	0.07		
		This study	1.587		0.15	0.09		
		Mean	**1.54**	**2.64**	**0.16**	**0.03**		
		Fan *et al*.(2009)[26]	0.122					
GBW07406a	Soil	This study	1.617		0.19	0.05	3	3
（IGGE）		This study	1.61		0.15	0.03		
		This study	1.632		0.17	0.08		
		Mean	**1.619**	**0.69**	**0.17**	**0.04**		
GBW07315	Marine	This study	0.12		0.17	0.07	3	3
（NRCG）	sediment	This study	0.119		0.21	0.07		
		This study	0.117		0.23	0.02		
		Mean	**0.119**	**1.28**	**0.20**	**0.06**		
GBW07295	polymetallic	This study	0.338		0.07	0.04	3	3
（NRCG）	nodule	This study	0.339		0.03	0.04		
		This study	0.358		0.02	0.06		
		Mean	**0.345**	**3.27**	**0.04**	**0.05**		
GBW(E)070026	Sulfide	This study	45.89		0.14	0.07	2	3
（IGGE）		This study	47.83		0.10	0.01	2	3