Supporting Information for

An optimal method for magnesium purification and magnesium isotopic composition obtained by MC-ICP-MS

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Table S1. Result of acid molarity mismatch on Mg isotopic measurement.

Standard solution	HNO3 concentration (%)	$\delta^{25}Mg$	2SD	$\delta^{26}Mg$	2SD	n
Alfa-Mg	1%	0.05	0.01	0.01	0.02	4
Alfa-Mg	2%	0.00	0.01	0.00	0.01	4
Alfa-Mg	3%	-0.03	0.01	-0.12	0.02	4
Alfa-Mg	4%	-0.06	0.08	-0.14	0.05	4
Alfa-Mg	5%	-0.15	0.04	-0.24	0.05	4
Alfa-Mg	6%	-0.22	0.04	-0.36	0.01	4
Alfa-Mg	7%	-0.28	0.06	-0.46	0.10	4
Alfa-Mg	1%	0.00	0.04	-0.04	0.03	4
Alfa-Mg	2%	0.01	0.02	0.00	0.02	4
Alfa-Mg	3%	0.00	0.05	-0.05	0.06	4
Alfa-Mg	4%	-0.03	0.04	-0.09	0.07	4
Alfa-Mg	5%	-0.09	0.09	-0.15	0.13	4
Alfa-Mg	6%	-0.17	0.07	-0.26	0.08	4
Alfa-Mg	7%	-0.17	0.09	-0.30	0.10	4

Table S2. Result of concentration mismatch on Mg isotopic measurement.

Standard solution	Sample/standard concentration ratio	δ^{25}Mg	2SD	δ^{26}Mg	2SD	n
Alfa-Mg	0.824	-0.01	0.01	0.02	0.02	4
Alfa-Mg	1.622	-0.01	0.03	-0.03	0.04	4
Alfa-Mg	2.332	0.01	0.05	0.01	0.11	4
Alfa-Mg	3.674	0.07	0.10	0.04	0.14	4
Alfa-Mg	0.972	0.02	0.02	0.01	0.02	4
Alfa-Mg	0.748	-0.02	0.02	-0.07	0.03	4
Alfa-Mg	0.634	0.03	0.06	0.01	0.08	4
Alfa-Mg	0.406	-0.02	0.01	-0.05	0.04	4
Alfa-Mg	0.206	0.00	0.03	-0.05	0.05	4
Alfa-Mg	1.318	-0.02	0.03	-0.06	0.05	4
Alfa-Mg	1.697	-0.02	0.04	-0.07	0.08	4
Alfa-Mg	2.508	0.00	0.03	-0.02	0.08	4
Alfa-Mg	6.776	-0.30	0.09	0.07	0.06	4
Alfa-Mg	0.824	-0.01	0.01	0.02	0.01	4
Alfa-Mg	1.215	0.01	0.02	-0.02	0.04	5
Alfa-Mg	0.616	-0.01	0.03	0.02	0.07	5
Alfa-Mg	0.429	-0.02	0.06	-0.03	0.08	5
Alfa-Mg	0.272	-0.03	0.04	-0.07	0.06	5
Alfa-Mg	1.029	-0.02	0.04	-0.01	0.08	5
Alfa-Mg	1.339	0.00	0.01	0.03	0.02	5
Alfa-Mg	1.767	0.00	0.02	0.02	0.04	5
Alfa-Mg	2.866	-0.01	0.04	0.02	0.07	5
Alfa-Mg	4.863	-0.02	0.03	0.02	0.05	5
Alfa-Mg	0.759	0.01	0.03	0.04	0.05	5
Alfa-Mg	0.589	0.01	0.04	0.04	0.06	5
Alfa-Mg	0.399	0.00	0.04	0.02	0.07	5
Alfa-Mg	0.148	-0.01	0.06	-0.09	0.05	5

Table S3. Doping experiments to test the matrix effect on Mg isotopic analyses

Standard solution	doping element	Matrix element/Mg (molar ratio)	δ^{25}Mg	2SD	δ^{26}Mg	2SD	n
Alfa-Mg	Zn	0.037	0.01	0.05	0.04	0.03	4
Alfa-Mg	Zn	0.074	0.01	0.02	0.01	0.04	4
Alfa-Mg	Zn	0.185	0.01	0.06	0.00	0.05	4
Alfa-Mg	Zn	0.369	0.00	0.02	0.02	0.04	4
Alfa-Mg	Zn	0.738	0.03	0.05	0.03	0.07	4
Alfa-Mg	Zn	0.738	0.00	0.03	-0.01	0.06	4
Alfa-Mg	Zn	1.846	0.01	0.02	0.00	0.07	4
Alfa-Mg	Zn	3.692	-0.04	0.04	-0.04	0.05	4
Alfa-Mg	Sr	0.014	0.02	0.05	0.02	0.04	4
Alfa-Mg	Sr	0.028	0.01	0.11	0.03	0.10	4
Alfa-Mg	Sr	0.055	0.01	0.03	0.01	0.05	4
Alfa-Mg	Sr	0.138	0.02	0.04	0.03	0.06	4
Alfa-Mg	Sr	0.276	0.01	0.04	0.06	0.07	4
Alfa-Mg	Sr	1.379	0.05	0.07	0.10	0.06	4
Alfa-Mg	Sr	2.759	0.03	0.03	0.05	0.03	4
Alfa-Mg	Fe	0.021	0.01	0.07	0.02	0.03	4
Alfa-Mg	Fe	0.043	-0.01	0.03	0.00	0.04	4
Alfa-Mg	Fe	0.086	-0.03	0.06	0.01	0.06	4
Alfa-Mg	Fe	0.214	0.01	0.05	0.02	0.02	4
Alfa-Mg	Fe	0.429	0.03	0.08	0.08	0.15	4
Alfa-Mg	Fe	0.857	0.04	0.05	0.10	0.11	4
Alfa-Mg	Fe	1.071	0.05	0.04	0.14	0.11	4
Alfa-Mg	Fe	2.143	0.07	0.06	0.16	0.08	4
Alfa-Mg	Ti	0.005	0.01	0.07	0.04	0.06	4
Alfa-Mg	Ti	0.025	-0.01	0.03	-0.03	0.06	4
Alfa-Mg	Ti	0.05	-0.02	0.02	-0.09	0.04	4
Alfa-Mg	Ti	0.1	-0.11	0.14	-0.28	0.18	4
Alfa-Mg	Ti	0.25	-0.38	0.12	-0.83	0.12	4
Alfa-Mg	Ti	0.5	-0.78	0.21	-1.72	0.29	5
Alfa-Mg	Ti	0.25	-0.34	0.05	-0.78	0.05	5
Alfa-Mg	Ti	0.5	-0.71	0.04	-1.60	0.05	4
Alfa-Mg	Ti	1	-1.41	0.04	-3.23	0.02	4
Alfa-Mg	Ca	0.06	0.03	0.01	0.09	0.03	4
Alfa-Mg	Ca	0.12	0.07	0.05	0.19	0.07	4
Alfa-Mg	Ca	0.3	0.07	0.06	0.22	0.07	4
Alfa-Mg	Ca	0.6	0.08	0.07	0.29	0.13	4
Alfa-Mg	Ca	0.9	0.05	0.09	0.28	0.12	4
Alfa-Mg	Ca	1.2	0.05	0.10	0.31	0.12	4
Alfa-Mg	Ca	3	-0.06	0.06	0.31	0.11	4
Alfa-Mg	Ca	0.006	-0.02	0.07	0.03	0.05	4
Alfa-Mg	Ca	0.03	0.01	0.06	0.02	0.02	4
Alfa-Mg	Ca	0.06	0.01	0.02	0.05	0.06	4

Alfa-Mg	Ca	0.12	0.03	0.05	0.08	0.09	4
Alfa-Mg	K	0.062	0.00	0.03	0.00	0.04	4
Alfa-Mg	K	0.123	0.00	0.01	0.01	0.03	4
Alfa-Mg	K	0.308	0.01	0.03	0.01	0.01	4
Alfa-Mg	K	0.615	0.05	0.03	0.11	0.01	4
Alfa-Mg	K	0.923	0.08	0.01	0.17	0.04	4
Alfa-Mg	K	1.231	0.04	0.02	0.08	0.06	4
Alfa-Mg	K	3.077	0.06	0.01	0.14	0.04	4
Alfa-Mg	Al	0.044	0.00	0.07	0.02	0.06	4
Alfa-Mg	Al	0.089	0.02	0.09	0.06	0.02	4
Alfa-Mg	Al	0.178	0.03	0.06	0.06	0.09	4
Alfa-Mg	Al	0.444	-0.01	0.09	-0.02	0.10	4
Alfa-Mg	Al	0.889	-0.11	0.14	-0.21	0.11	4
Alfa-Mg	Al	1.778	-0.15	0.02	-0.32	0.04	4
Alfa-Mg	Al	0.089	0.01	0.04	0.03	0.06	4
Alfa-Mg	Al	0.444	-0.06	0.17	-0.12	0.07	4
Alfa-Mg	Al	0.889	-0.14	0.03	-0.27	0.02	4
Alfa-Mg	Na	0.209	-0.01	0.02	-0.03	0.07	4
Alfa-Mg	Na	0.522	-0.03	0.03	-0.05	0.07	4
Alfa-Mg	Na	1.043	-0.02	0.06	0.02	0.06	4
Alfa-Mg	Na	1.565	-0.06	0.06	-0.01	0.11	4
Alfa-Mg	Na	0.104	0.00	0.05	-0.01	0.03	4
Alfa-Mg	Na	2.087	-0.03	0.07	0.21	0.07	4
Alfa-Mg	Na	5.217	-0.15	0.06	0.34	0.03	4
Alfa-Mg	Na	2.087	0.00	0.06	0.34	0.27	4

Table S4. Mg isotopic compositions of reference materials reported in this study and previous studies

Sample	δ^{26}Mg	U/2SD	δ^{25}Mg	U/2SD	n	Comets/reference
BHVO-2	-0.27	0.05	-0.14	0.04	5	Digestion in 6/2019
BHVO-2	-0.26	0.07	-0.14	0.03	5	Digestion in 6/2019
BHVO-2	-0.21	0.03	-0.11	0.02	6	Digestion in 11/2019
BHVO-2	-0.21	0.07	-0.11	0.03	6	Digestion in 11/2019
BHVO-2	-0.29	0.02	-0.15	0.02	5	Digestion in 9/2020
BHVO-2	-0.29	0.03	-0.15	0.01	5	Digestion in 9/2020
BHVO-2	-0.25	0.05	-0.13	0.03	32	Mean value
BHVO-2	-0.24	0.08	-0.12	0.05	\	(Teng et al., 2015a)
BHVO-2	-0.19	0.02	-0.10	0.01	10	(Bizzarro et al., 2011)
BHVO-2	-0.14	0.08	-0.06	0.11	7	(Wiechert and Halliday, 2007)
BHVO-2	-0.25	0.11	-0.13	0.08	5	(Pogge von Strandmann et al., 2008)
BHVO-2	-0.26	0.06	-0.14	0.04	4	(Pogge von Strandmann et al., 2011)
BHVO-2	-0.20	0.08	-0.10	0.03	\	(Bouvier et al., 2013)
BHVO-2	-0.26	0.04	-0.14	0.02	4	(Huang et al., 2015a)
BHVO-2	-0.34	0.07	\	\	\	(Huang et al., 2015b)
BHVO-2	-0.22	0.04	-0.10	0.03	14	(An et al., 2014)
BHVO-2	-0.19	0.09	-0.11	0.06	34	(Bao et al., 2019)
BCR-2	-0.18	0.05	-0.09	0.03	5	Digestion in 6/2019
BCR-2	-0.19	0.03	-0.10	0.10	5	Digestion in 11/2019
BCR-2	-0.19	0.09	-0.01	0.06	5	Digestion in 9/2020
BCR-2	-0.20	0.05	-0.11	0.03	5	Digestion in 9/2020
BCR-2	-0.19	0.06	-0.08	0.06	20	Mean value
BCR-2	-0.16	0.11	-0.09	0.05	19	(Tipper et al., 2008)
BCR-2	-0.26	0.06	-0.13	0.00	18	(Pogge von Strandmann et al., 2011)
BCR-2	-0.34	0.12	\	\	\	(Huang et al., 2011)
BCR-2	-0.12	0.04	-0.06	0.02	29	(Bourdon et al., 2010)
BCR-2	-0.14	0.11	-0.07	0.06	\	(Wombacher et al., 2009)
BCR-2	-0.33	0.08	-0.16	0.09	32	(Teng et al., 2007)
BCR-2	-0.17	0.35	-0.09	0.17	7	(Bizzarro et al., 2005)
BCR-2	-0.30	0.11	-0.15	0.07	16	(Huang et al., 2009)
BCR-2	-0.20	0.07	\	\	36	(Wimpenny et al., 2014)
BCR-2	-0.30	0.19	-0.16	0.11	31	(Opfergelt et al., 2012)
BCR-2	-0.16	0.01	-0.08	0.02	35	(An et al., 2014)
BCR-2	-0.26	0.08	-0.13	0.05	54	(Lee et al., 2014)
BCR-2	-0.20	0.10	-0.09	0.05	39	(Bao et al., 2019)
DNC-1	-0.24	0.08	-0.12	0.04	5	Digestion in 6/2019
DNC-1	-0.22	0.08	-0.11	0.08	5	Digestion in 6/2019
DNC-1	-0.23	0.07	-0.12	0.05	5	Digestion in 11/2019
DNC-1	-0.27	0.08	-0.14	0.06	5	Digestion in 11/2019
DNC-1	-0.27	0.03	-0.14	0.02	5	Digestion in 9/2020
DNC-1	-0.24	0.09	-0.13	0.06	5	Digestion in 9/2020
DNC-1	-0.24	0.07	-0.13	0.05	30	Mean value

DNC-1	-0.22	0.05	-0.11	0.03	17	(An et al., 2014)
DNC-1	-0.25	0.03	-0.13	0.02	30	(Bao et al., 2019)
W2	-0.22	0.09	-0.11	0.05	5	Digestion in 6/2019
W2	-0.22	0.04	-0.12	0.03	5	Digestion in 6/2019
W2	-0.17	0.07	-0.09	0.03	6	Digestion in 11/2019
W2	-0.17	0.07	-0.09	0.03	6	Digestion in 11/2019
W2	-0.19	0.06	-0.10	0.03	5	Digestion in 9/2020
W2	-0.19	0.06	-0.10	0.04	5	Digestion in 9/2020
W2	-0.19	0.07	-0.10	0.04	32	Mean value
W2	-0.16	0.01	-0.08	0.03	\	(Teng et al., 2015a)
W2	-0.16	0.10	-0.09	0.06	3	(Wang et al., 2011)
W2	-0.15	0.01	-0.08	0.02	22	(An et al., 2014)
W2	-0.17	0.08	-0.07	0.05	4	(Lee et al., 2014)
W2	-0.14	0.05	-0.08	0.05	26	(Bao et al., 2019)
AGV-2	-0.11	0.06	-0.06	0.02	6	Digestion in 6/2019
AGV-2	-0.16	0.07	-0.08	0.03	6	Digestion in 11/2019
AGV-2	-0.22	0.04	-0.12	0.02	6	Digestion in 11/2019
AGV-2	-0.16	0.08	-0.09	0.06	6	Digestion in 9/2020
AGV-2	-0.14	0.07	-0.07	0.04	6	Digestion in 9/2020
AGV-2	-0.16	0.06	-0.08	0.03	30	Mean value
AGV-2	-0.15	0.02	-0.07	0.03	4	(Huang et al., 2015a)
AGV-2	-0.24	0.24	-0.14	0.13	28	(Opfergelt et al., 2012)
AGV-2	-0.12	0.03	-0.06	0.03	11	(An et al., 2014)
AGV-2	-0.21	0.09	-0.12	0.07	7	(Lee et al., 2014)
AGV-2	-0.14	0.07	-0.07	0.03	20	(Bao et al., 2019)
GSP-2	0.00	0.07	0.00	0.04	5	Digestion in 6/2019
GSP-2	-0.02	0.07	-0.01	0.07	5	Digestion in 6/2019
GSP-2	0.04	0.08	0.02	0.05	5	Digestion in 11/2019
GSP-2	-0.02	0.08	-0.01	0.04	5	Digestion in 11/2019
GSP-2	0.04	0.05	0.02	0.03	5	Digestion in 9/2020
GSP-2	0.06	0.04	0.03	0.05	5	Digestion in 9/2020
GSP-2	0.02	0.07	0.01	0.05	30	Mean value
GSP-2	0.04	0.02	0.03	0.01	15	(An et al., 2014)
GSP-2	0.03	0.09	0.00	0.06	4	(Huang et al., 2015a)
GSP-2	-0.02	0.02	0.03	0.01	14	(Opfergelt et al., 2012)
GSP-2	0.09	0.03	0.05	0.02	26	(Bao et al., 2019)
RGM-2	-0.22	0.02	-0.12	0.02	6	Digestion in 6/2019
RGM-2	-0.17	0.06	-0.09	0.05	6	Digestion in 6/2019
RGM-2	-0.21	0.11	-0.11	0.04	6	Digestion in 11/2019
RGM-2	-0.21	0.06	-0.10	0.08	6	Digestion in 11/2019
RGM-2	-0.27	0.05	-0.14	0.03	6	Digestion in 9/2020
RGM-2	-0.24	0.08	-0.13	0.05	6	Digestion in 9/2020
RGM-2	-0.22	0.06	-0.11	0.04	36	Mean value
RGM-2	-0.18	0.04	-0.09	0.03	72	(An et al., 2014)

RGM-2	-0.24	0.07	-0.12	0.03	26	(Bao et al., 2019)
COQ-1	-0.44	0.07	-0.23	0.08	5	Digestion in 6/2019
COQ-1	-0.52	0.09	-0.27	0.05	5	Digestion in 6/2019
COQ-1	-0.53	0.03	-0.28	0.03	6	Digestion in 11/2019
COQ-1	-0.47	0.09	-0.24	0.04	6	Digestion in 11/2019
COQ-1	-0.41	0.05	-0.21	0.02	5	Digestion in 9/2020
COQ-1	-0.45	0.11	-0.23	0.06	5	Digestion in 9/2020
COQ-1	-0.47	0.07	-0.24	0.04	32	Mean value
COQ-1	-0.50	0.06	-0.25	0.04	9	(Gao et al., 2019)
SDC-1	-0.16	0.05	-0.09	0.05	6	Digestion in 6/2019
SDC-1	-0.15	0.04	-0.08	0.02	6	Digestion in 11/2019
SDC-1	-0.12	0.04	-0.07	0.00	6	Digestion in 9/2020
SDC-1	-0.14	0.04	-0.08	0.03	18	Mean value
SDC-1	-0.11	0.03	-0.06	0.05	4	(Teng et al., 2015a)
Seawater	-0.86	0.05	-0.45	0.02	6	This study
Seawater	-0.86	0.07	-0.45	0.03	6	This study
Seawater	-0.86	0.06	-0.45	0.04	6	This study
Seawater	-0.84	0.01	-0.44	0.03	6	This study
Seawater	-0.79	0.06	-0.42	0.02	6	This study
Seawater	-0.82	0.08	-0.43	0.03	6	This study
Seawater	-0.84	0.06	-0.44	0.03	36	Mean value
Seawater	-0.83	0.09	-0.43	0.06	/	(Teng, 2017)
GSB-14	-0.84	0.02	-0.44	0.01	4	Digestion in 3/2021
GSB-14	-0.85	0.04	-0.44	0.01	4	Digestion in 3/2021
GSB-14	-0.84	0.04	-0.44	0.01	4	Digestion in 3/2021
GSB-14	-0.84	0.03	-0.44	0.01	12	Mean value
GSB-19	-0.79	0.05	-0.39	0.03	4	Digestion in 3/2021
GSB-19	-0.79	0.06	-0.40	0.03	4	Digestion in 3/2021
GSB-19	-0.78	0.02	-0.39	0.02	4	Digestion in 3/2021
GSB-19	-0.79	0.04	-0.39	0.03	12	Mean value