Electronic Supplementary Material (ESI) for Journal of Analytical Atomic Spectrometry.

Supporting information

Determination of trace rare earth elements in uranium ore samples by triple quadrupole inductively coupled plasma mass spectrometry

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Table S1. Main polyatmic interferences for the measurement of REEs by ICP-MS.

Isotopes	Polyatomic interferences
^{139}La	$^{99}Ru^{40}Ar$, $^{123}Sb^{16}O$, $^{123}Te^{16}O$
^{140}Ce	$^{100}Ru^{40}Ar$, $^{100}Mo^{40}Ar$, $^{124}Te^{16}O$, $^{124}Sn^{16}O$
^{141}Pr	$^{101}Ru^{40}Ar$, $^{125}Te^{16}O$
^{146}Nd	$^{106}Pd^{40}Ar$, $^{106}Cd^{40}Ar$, $^{130}Xe^{16}O$, $^{130}Te^{16}O$, $^{130}Ba^{16}O$
^{147}Sm	$^{107}Ag^{40}Ar$, $^{131}Xe^{16}O$
^{153}Eu	$^{113}In^{40}Ar$, $^{113}Cd^{40}Ar$, $^{137}Ba^{16}O$
^{157}Gd	$^{117}Sn^{40}Ar$, $^{141}Pr^{16}O$
^{159}Tb	$^{119}Sn^{40}Ar$, $^{143}Nd^{16}O$, $^{142}Ce^{16}OH$, $^{142}Nd^{16}OH$
^{163}Dy	$^{123}Sb^{40}Ar$, $^{123}Te^{40}Ar$, $^{147}Sm^{16}O$, $^{146}Nd^{16}OH$
^{165}Ho	$^{125}Te^{40}Ar$, $^{149}Sm^{16}O$, $^{148}Nd^{16}OH$, $^{148}Sm^{16}OH$
^{166}Er	$^{126}Te^{40}Ar$, $^{150}Sm^{16}O$, $^{150}Nd^{16}O$
^{169}Tm	$^{129}Xe^{40}Ar$, $^{133}Cs^{36}Ar$, $^{153}Eu^{16}O$, $^{152}Sm^{16}OH$
^{172}Yb	$^{132}Xe^{40}Ar$, $^{156}Gd^{16}O$, $^{155}Gd^{16}OH$
^{175}Lu	$^{135}Ba^{40}Ar$, $^{139}La^{36}Ar$, $^{159}Tb^{16}O$, $^{158}Gd^{16}OH$

Table S2. Elements and their concentrations in the mixed testing solution.

Element	Concentration (ng mL^{-1})	Element	Concentration (ng mL^{-1})
Ag	500	Pb	500
Al	500	Rb	500
As	500	Se	500
Ba	500	Sr	500
Be	500	Tl	500
Ca	500	U	500
Cd	500	V	500
Co	500	Zn	500
Cr	500	Au	500
Cs	500	Hf	500
Cu	500	Ir	500
Fe	500	Pd	500
Ga	500	Pt	500
K	500	Rh	500
Li	500	Ru	500
Ma	500	Sb	500
Mn	500	Sn	500
Na	500	Te	500
Ni	500	-	-

Table S3. Analytical results of REEs in the geological reference materials.

Element	JB-2 (μg g^{-1})			JB-3 (μg g^{-1})			BCR-2 (μg g^{-1})			JA-2 (μg g^{-1})		JR-2 (μg g^{-1})	
	This work	Ebihara et al. [1,a]	Kamioka et al., [2,b]	This work	Ebihara et al.[1,a]	Kamioka et al., [2,b]	This work	Ebihara et al. [1,a]	Raczek et al., [3,c]	Tnis work	Navarro et al.[4,d]	This work	Navarro et al.[4,d]
La	2.29±0.07	2.30±0.10	2.25	8.38±0.10	8.43±0.42	8.27	24.22±0.18	25.0±0.2	24.9±0.2	15.17±0.22	16.6±0.6	12.96±0.23	16.2±0.2
Ce	6.57±0.18	6.51±0.24	6.65	20.46±0.22	21.0±1.1	21.2	49.87±0.55	52.7±0.6	52.9±0.1	31.03±0.42	33.7±0.6	32.27±0.56	38.8±0.4
Pr	1.15±0.03	1.13±0.04	-	3.21±0.04	3.22±0.16	-	6.78±0.08	6.69±0.06	-	3.66±0.05	5.3±1.1	4.32±0.07	5.3±0.3
Nd	6.21±0.20	6.12±0.27	6.22	15.16±0.20	15.3±0.9	15.5	27.70±0.21	28.1±0.2	28.7±0.1	13.75±0.23	14.5±0.2	16.81±0.25	19.7±0.04
Sm	2.22±0.07	2.15±0.09	2.24	4.12±0.06	4.12±0.24	4.14	6.48±0.08	6.53±0.07	6.57±0.03	2.97±0.02	3±0.05	4.73±0.08	5.16±0.03
Eu	0.84±0.04	0.78±0.03	0.83	1.28±0.01	1.29±0.06	1.32	1.92±0.02	1.92±0.02	1.96±0.01	0.86±0.01	0.96±0.01	0.08±0.002	0.06±0.01
Gd	3.15±0.09	2.99±0.15	3.21	4.48±0.05	4.49±0.34	4.63	6.55±0.04	6.71±0.05	6.75±0.03	2.96±0.02	3.11±0.01	5.03±0.08	5.92±0.01
Tb	0.58±0.02	0.54±0.04	-	0.72±0.01	0.68±0.06	-	1.04±0.01	1.04±0.01	-	0.47±0.01	0.83±0.01	0.93±0.01	1.49±0.04
Dy	3.90±0.13	3.82±0.17	3.91	4.50±0.08	4.41±0.31	4.51	6.35±0.05	6.44±0.04	6.41±0.03	2.84±0.04	3.13±0.01	6.10±0.12	7.45±0.02
Ho	0.88±0.03	0.84±0.04	-	0.95±0.01	0.93±0.05	-	1.31±0.004	1.29±0.02	-	0.61±0.01	0.7±0.02	1.36±0.02	1.58±0.01
Er	2.56±0.07	2.50±0.11	2.57	2.66±0.04	2.57±0.18	2.67	3.64±0.03	3.71±0.03	3.66±0.01	1.72±0.02	2.77±0.01	4.19±0.06	5.8±0.1
Tm	0.38±0.02	0.36±0.02	-	0.38±0.004	0.366±0.025	-	0.53±0.003	0.517±0.01	-	0.25±0.004	0.39±0.01	0.69±0.01	0.88±0.01
Yb	2.30±0.07	2.39±0.13	2.58	2.25±0.06	2.44±0.19	2.49	3.06±0.05	3.37±0.05	3.38±0.02	1.51±0.07	1.73±0.01	4.42±0.09	5.54±0.01
Lu	0.38±0.01	0.37±0.02	0.39	0.36±0.01	0.357±0.036	0.37	0.49±0.01	0.497±0.01	0.52±0.06	0.24±0.003	0.27±0.01	0.74±0.02	0.93±0.01

[a] Data determined by ICP-MS. [1]
[b] Data determined by ID-TIMS. [2]
[c] Data determined by ID-TIMS. [3]
[d] Data determined by ICP-OES. [4]

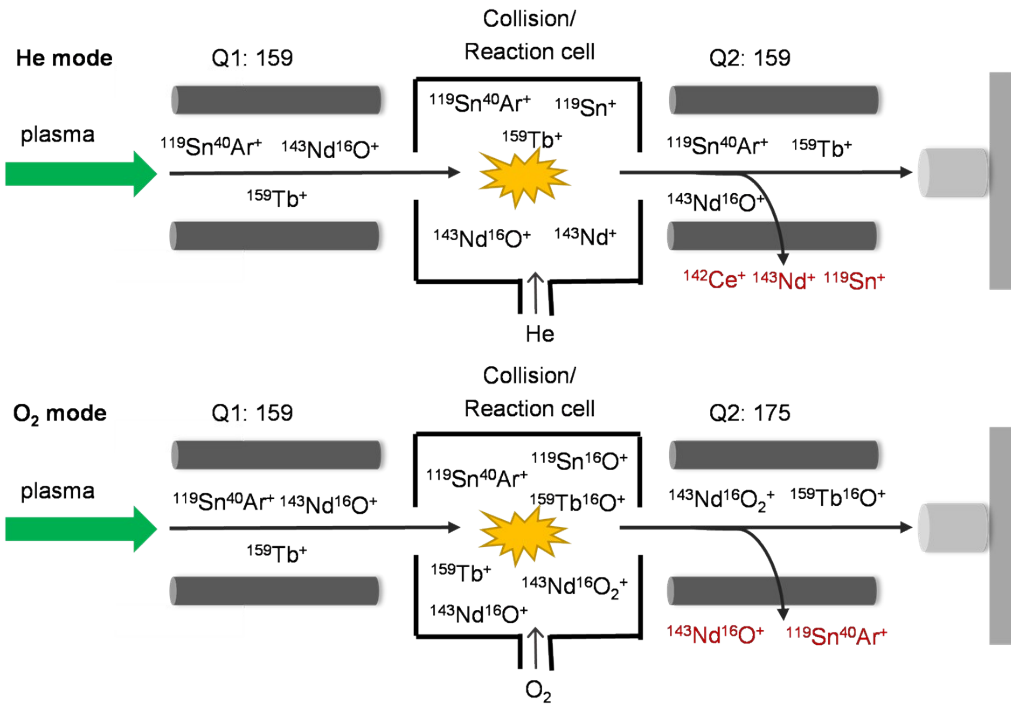

Figure S1. Schematic of ICP-MS/MS and ion-molecule reactions for ^{159}Tb measurements with He collision and O_2 reaction modes.

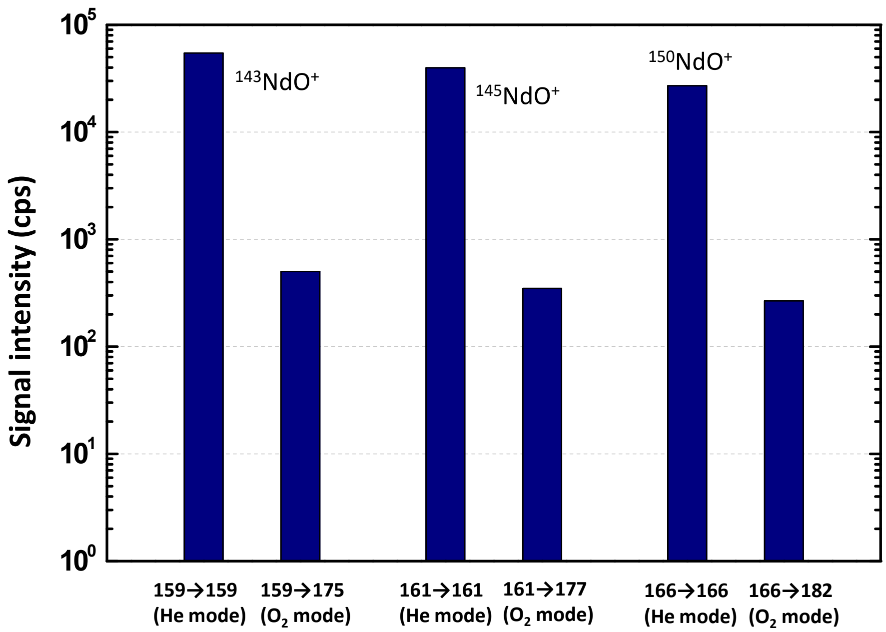

Figure S2. Background signal intensities of REE oxide interferences for the measurement of several REEs when analyzing 100 ng mL^{-1} Nd solution with He collision and O_2 reaction modes.

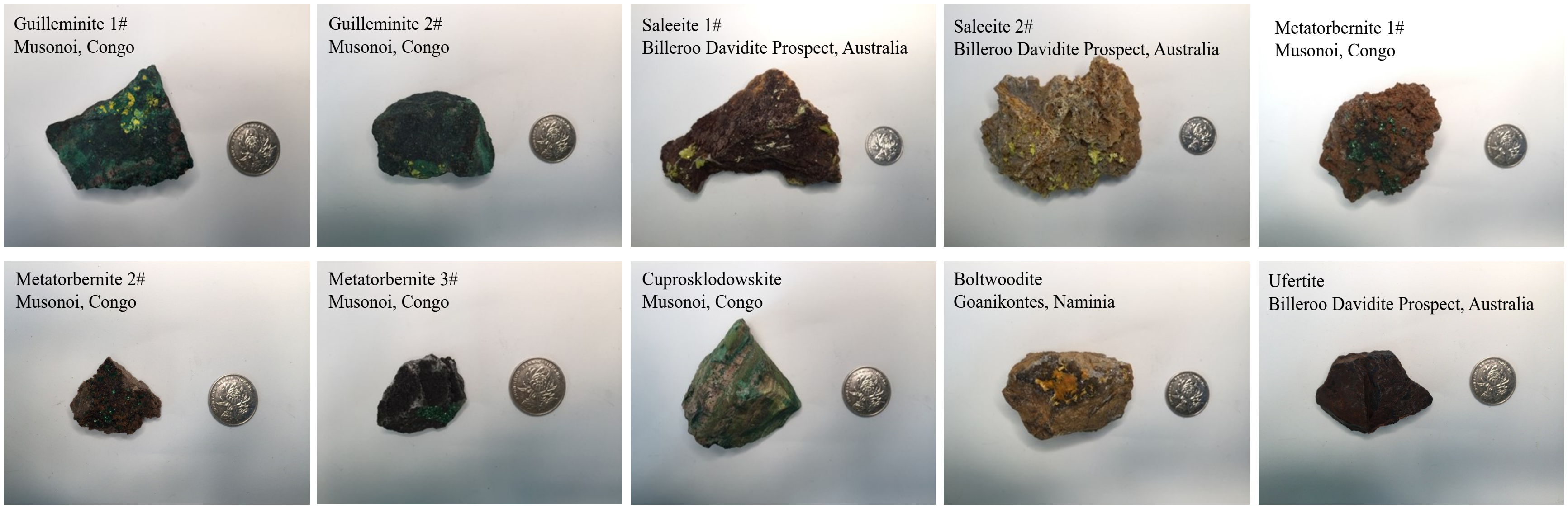

Fig. S3. Photos and basic information for the uranium ore samples.

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