Electronic supplementary information

Effects of ionization potential of an element and boiling point of the corresponding oxide on the sensitivity of ICP-MS

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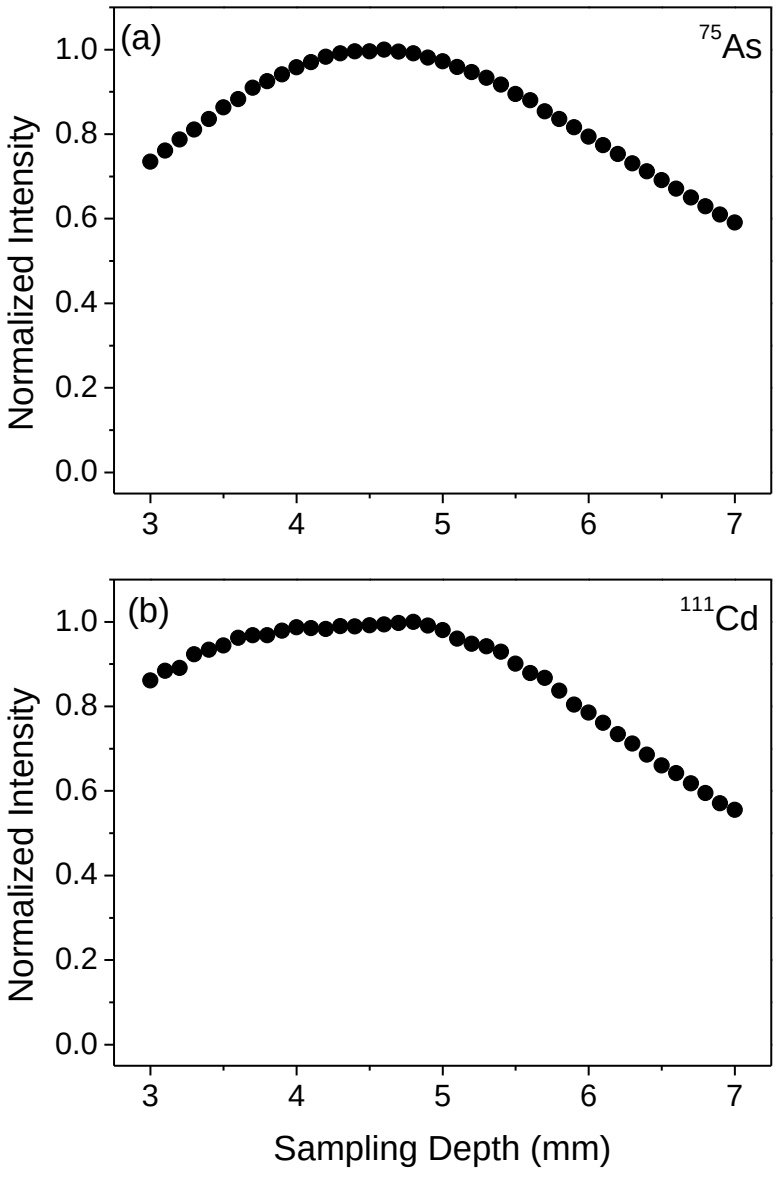
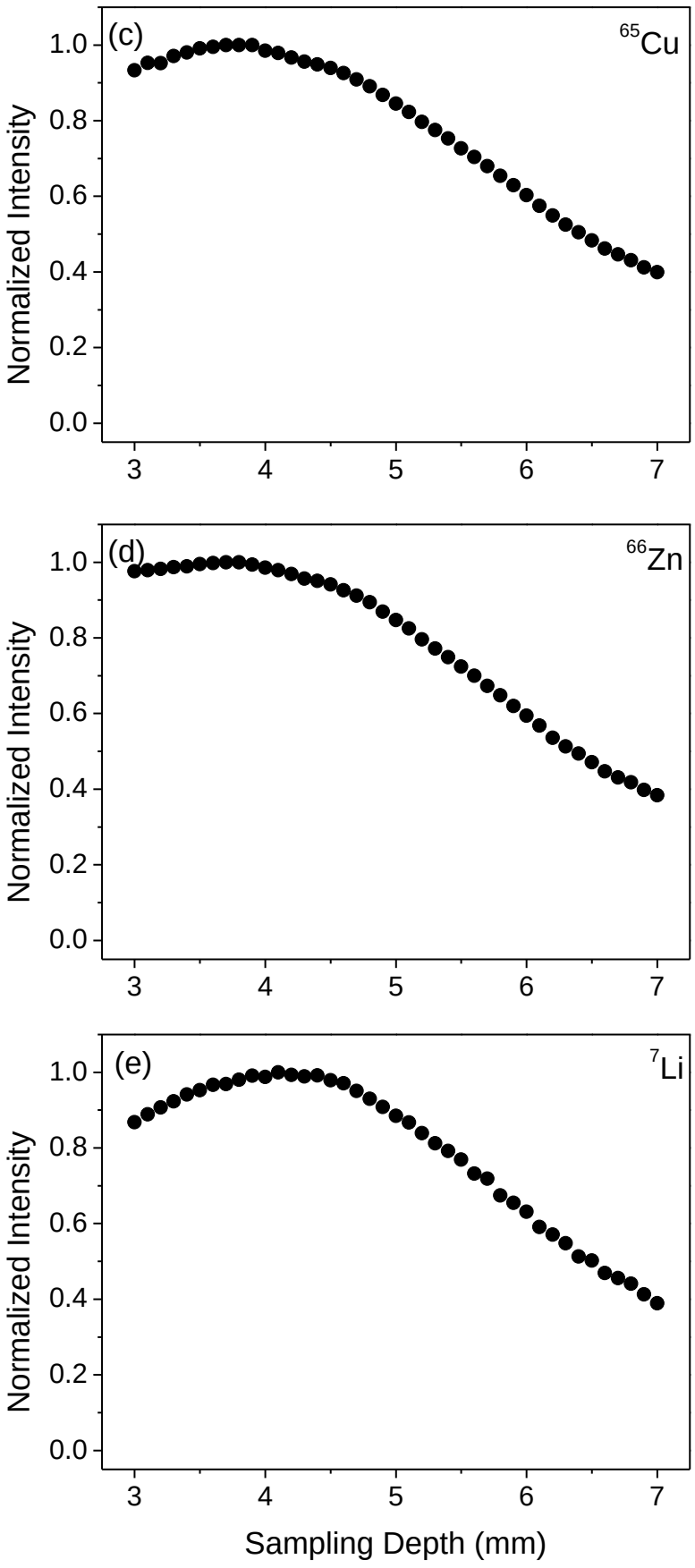
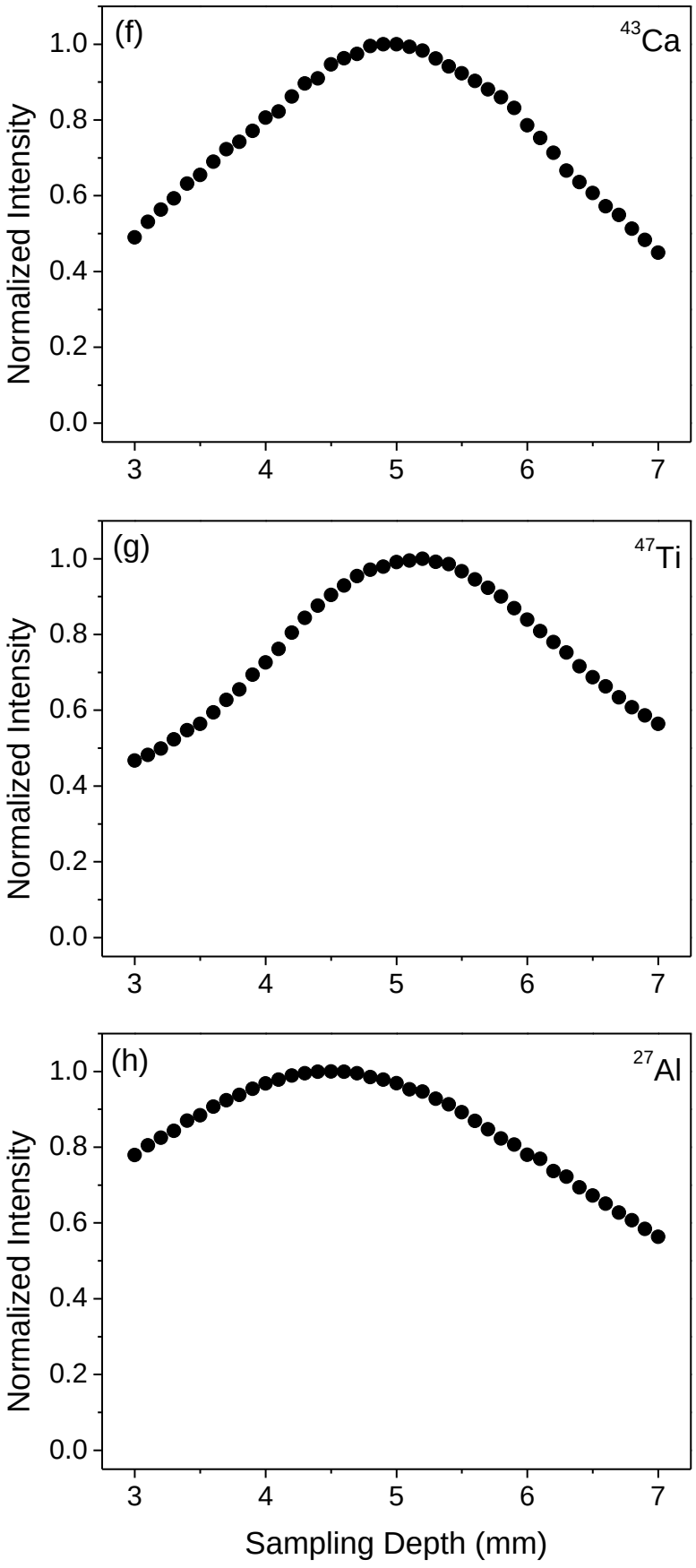
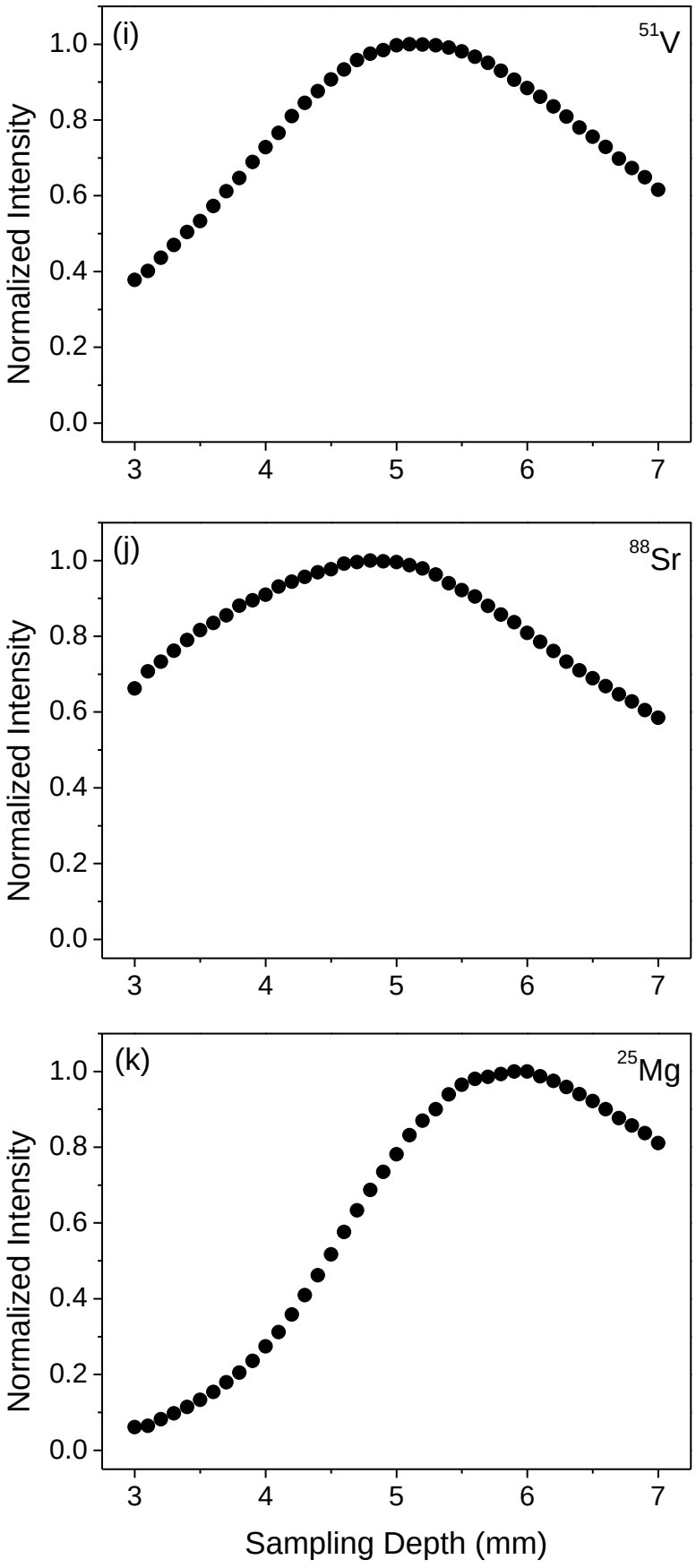
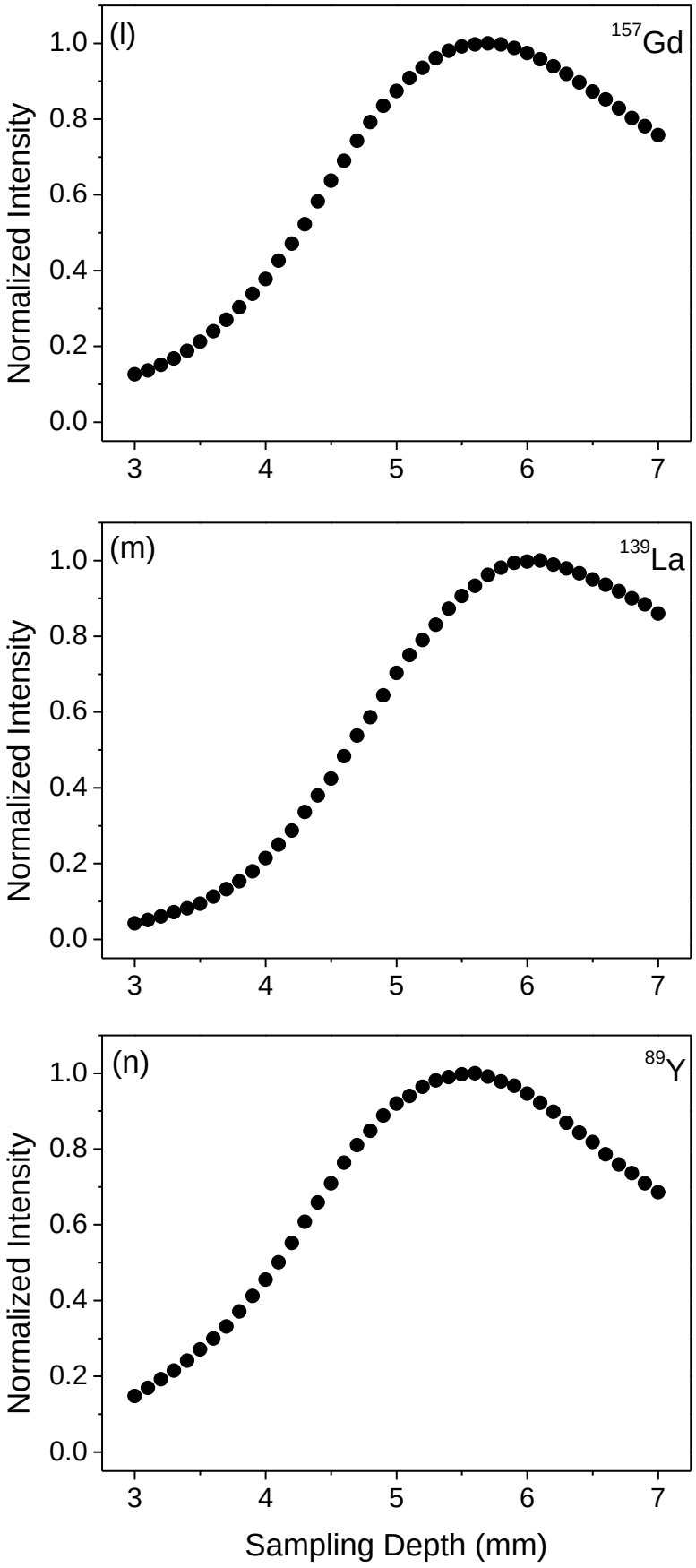



(c)
^{65}Cu
(d)
^{66}Zn
(e)
^{7}Li
Normalized Intensity
Sampling Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
3
4
5
6
7


(f)
^{43}Ca
(g)
^{47}Ti
(h)
^{27}Al
Normalized Intensity
Sampling Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
3
4
5
6
7


(i)
^{51}V
(j)
^{88}Sr
(k)
^{25}Mg
Normalized Intensity
Sampling Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
3
4
5
6
7


(l)
^{157}Gd
(m)
^{139}La
(n)
^{89}Y
Normalized Intensity
Sampling Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
3
4
5
6
7

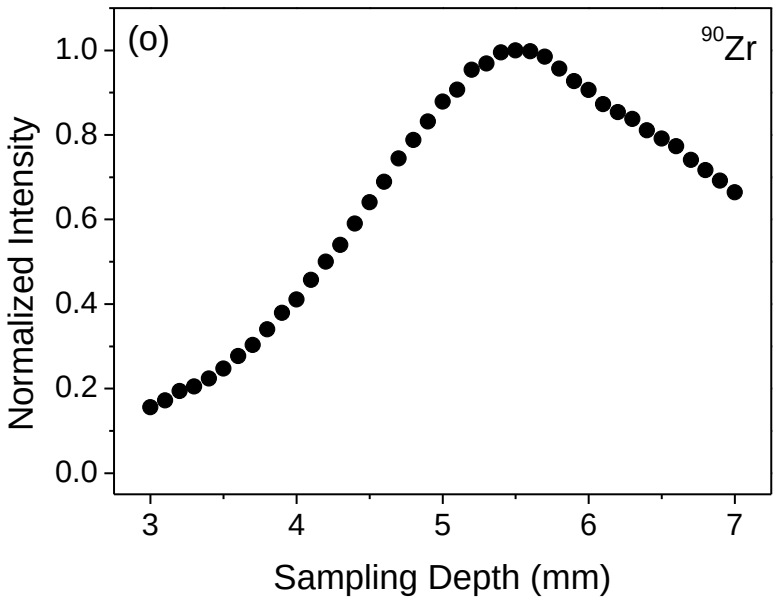


Figure S1. Sampling depth profiles of the 15 remaining elements.

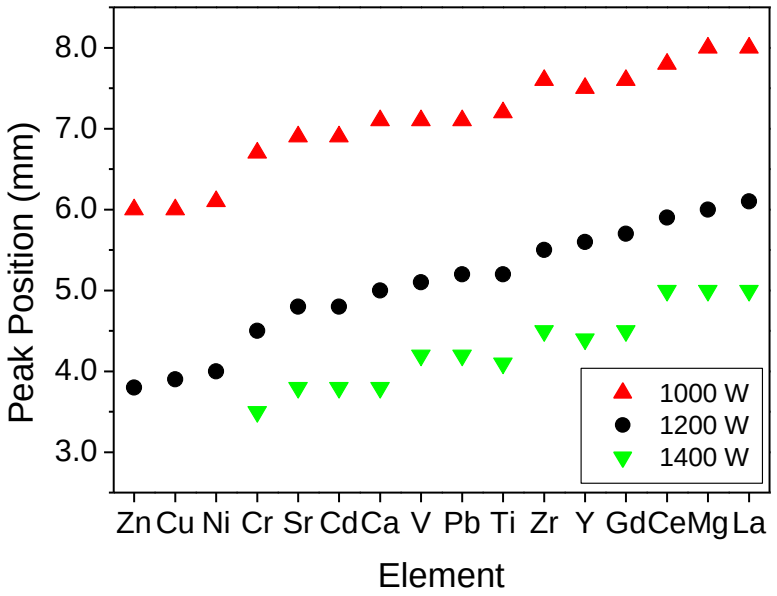


Figure S2. Peak position of the sampling depth profiles of 16 of the selected elements at different ICP forward powers. The elements are sorted in ascending order of the position of maximum sensitivity at 1200 W. The peak positions of Ni, Cu, and Zn at 1400 W are not shown because the corresponding peak positions are close to the measurement limit of 3.0 mm.

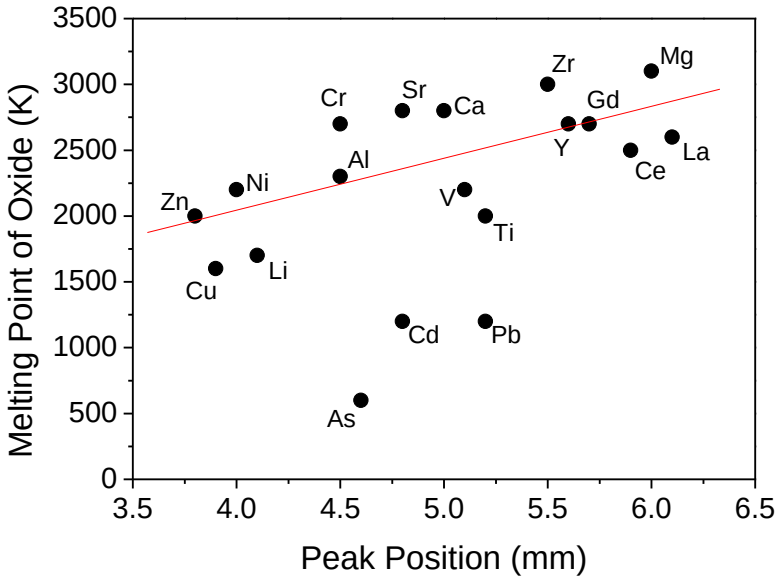


Figure S3. Melting point of the oxides *versus* the peak position of the ICP-MS sampling depth profile.

Repeatability of sampling depth profiles

Single-element standard solution of Ce of concentration of 10 µg/L was used to determine the repeatability of sampling depth setting. The sampling depth was 4.0 to 7.0 mm, in 0.1 mm increments. The depth profiles were nearly identical for three repeated measurements within two hours (Figure S4). The peak was located at 6.0 ± 0.1 mm above the ICP load coil. The step size of torch movement of 0.1 mm limits the repeatability. Nonetheless, the precision in sampling position is sufficient for the differentiation of the peak positions of the test elements.

The sampling depth profiles of the Ce standard solution obtained over two months in seven repetitions were similar in shape, but the range of peak position is increased to 6.0 ± 0.2 mm (Figure S5). The repeatability of the peak position of the ICP-MS sampling depth profile is still sufficiently high for inter-experiment comparison.

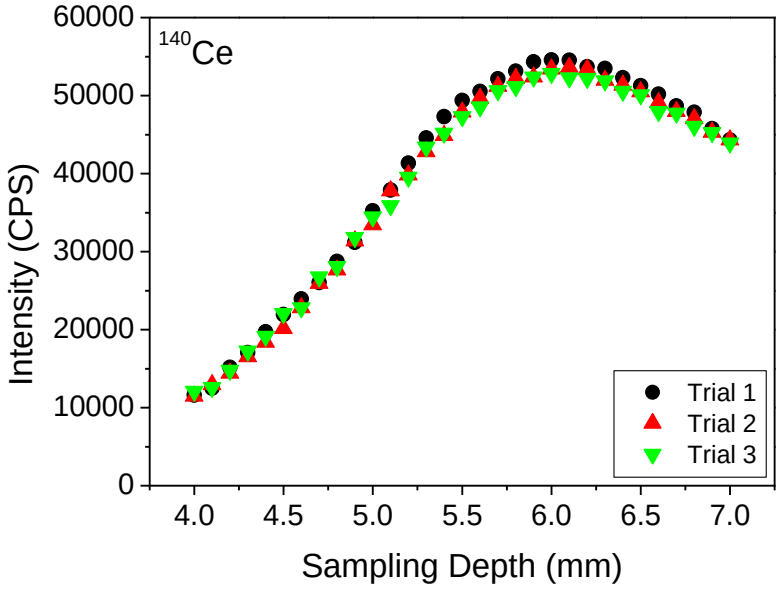


Figure S4. Sampling depth profiles of Ce of concentration of 10 µg/L in three trials within two hours.

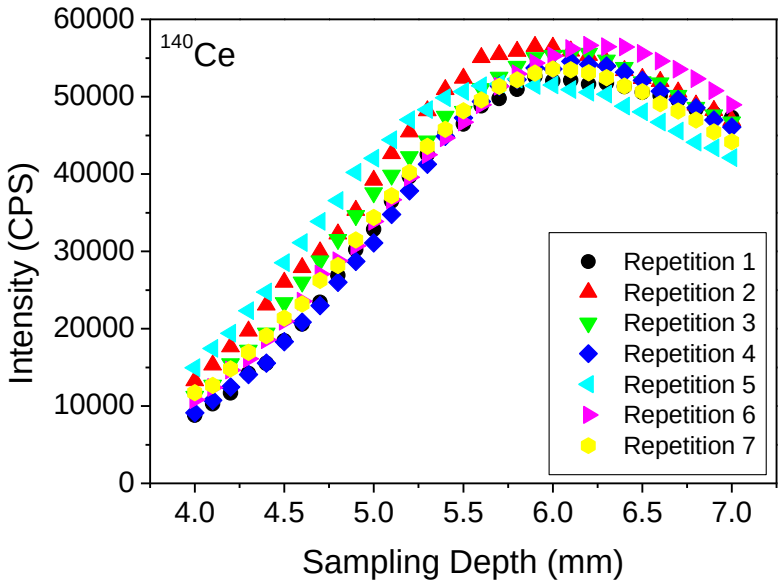


Figure S5. Sampling depth profiles of Ce of concentration of 10 µg/L over a duration of two months.

Effect of the isotope of an element

In Section 3.1, ^{140}Ce (abundance = 88.45%) was measured for standard solutions of Ce of concentration of 1 – 100 μg/L, while ^{138}Ce (abundance = 0.25%) was measured for the high concentration standard solutions (1000 – 10000 μg/L). The peak position of the ICP-MS sampling depth profile of the two isotopes are identical, which is expected for isotope measurement (Table S1).

Table S1. Position of maximum sensitivity for the Ce isotopes studied.

Isotope of Ce	Abundance (%)	Peak position (mm alc)
136	0.19	6.0
138	0.25	6.1
140	88.45	6.1
142	11.11	6.0

Single-element standard solution of Ce of 1 μg/mL was measured.

Table S2. Temperature for 80% ionization of the 19 selected elements.

Element	Temperature for 80% ionization (K)	Oxide boiling point (K)	Difference (K)
As	5500	740	4760
Cd	5700	1800	3900
Pb	4200	1800	2400
Ni	3400	2300	1100
Cu	4300	2300	2000
Zn	6000	2300	3700
Li	2700	2500	200
Ca	3400	3100	300
Ti	2900	3200	-300
Al	2800	3300	-500
V	2700	3300	-600
Cr	3200	3300	-100
Sr	3100	3300	-200
Mg	4700	3900	800
Ce	1800	4000	-2200
Gd	2300	4200	-1900
La	2200	4500	-2300
Y	2600	4600	-2000
Zr	2800	4600	-1800