Electronic Supplementary Information (ESI)

Selective recovery of zinc from goethite residue of the zinc industry using deep-eutectic solvents

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1 Characterization

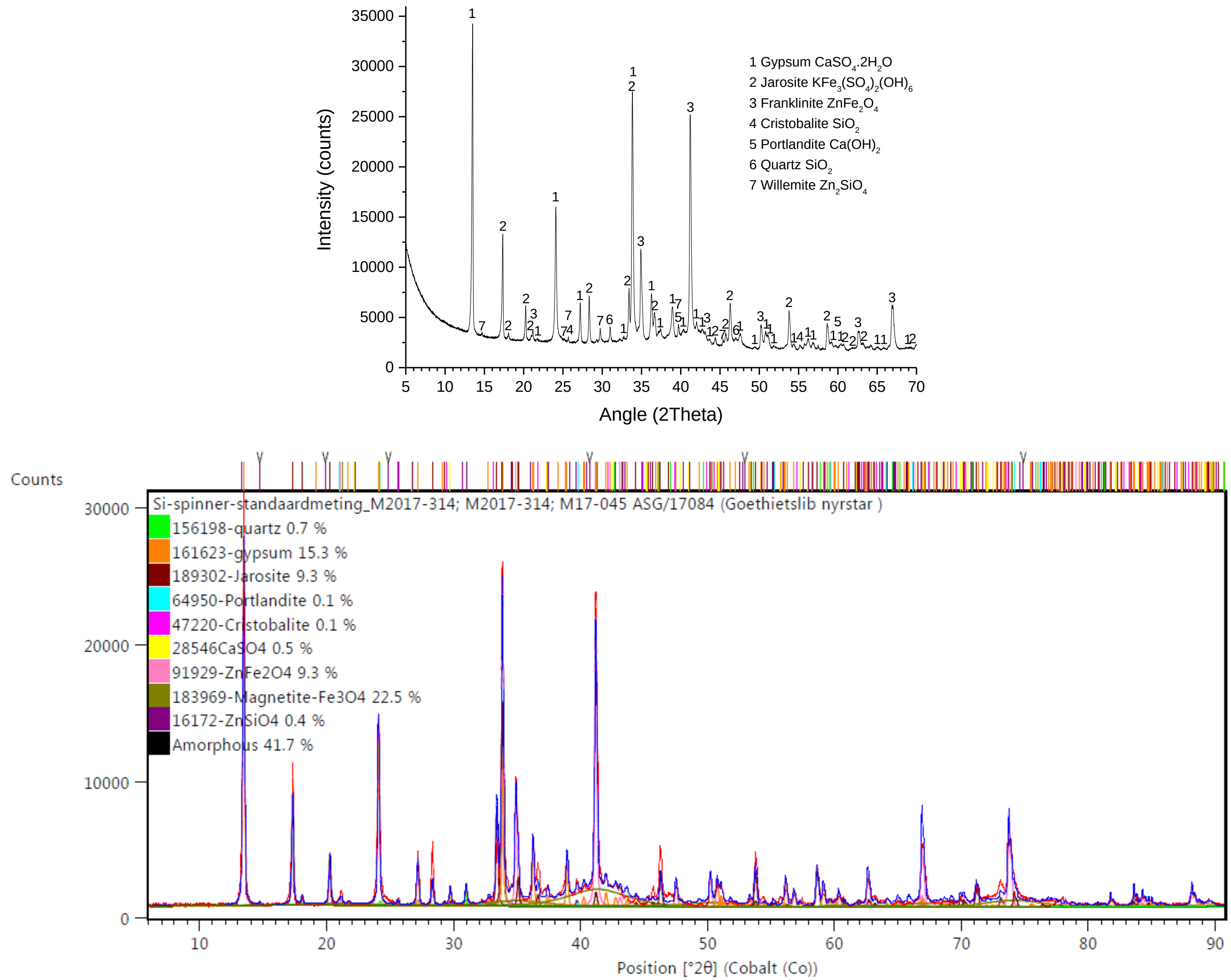

Figure S1: X-ray diffractogram of goethite: (top) assignment of phases to the peaks; (bottom) quantification (Rietveld) of phases

EPMA analysis has been used to investigate the distribution of the metals in the mineral phases. The elemental mappings of different particles show that the zinc is often combined with iron in different types of mineral phases (Figure S2), or surrounded by an iron oxide layer (Figure S3-S4). This type of distribution of suggests that the selective recovery of the zinc is complicated. Nonetheless, easily accessible zinc can be found in some small particles (Figure S5).

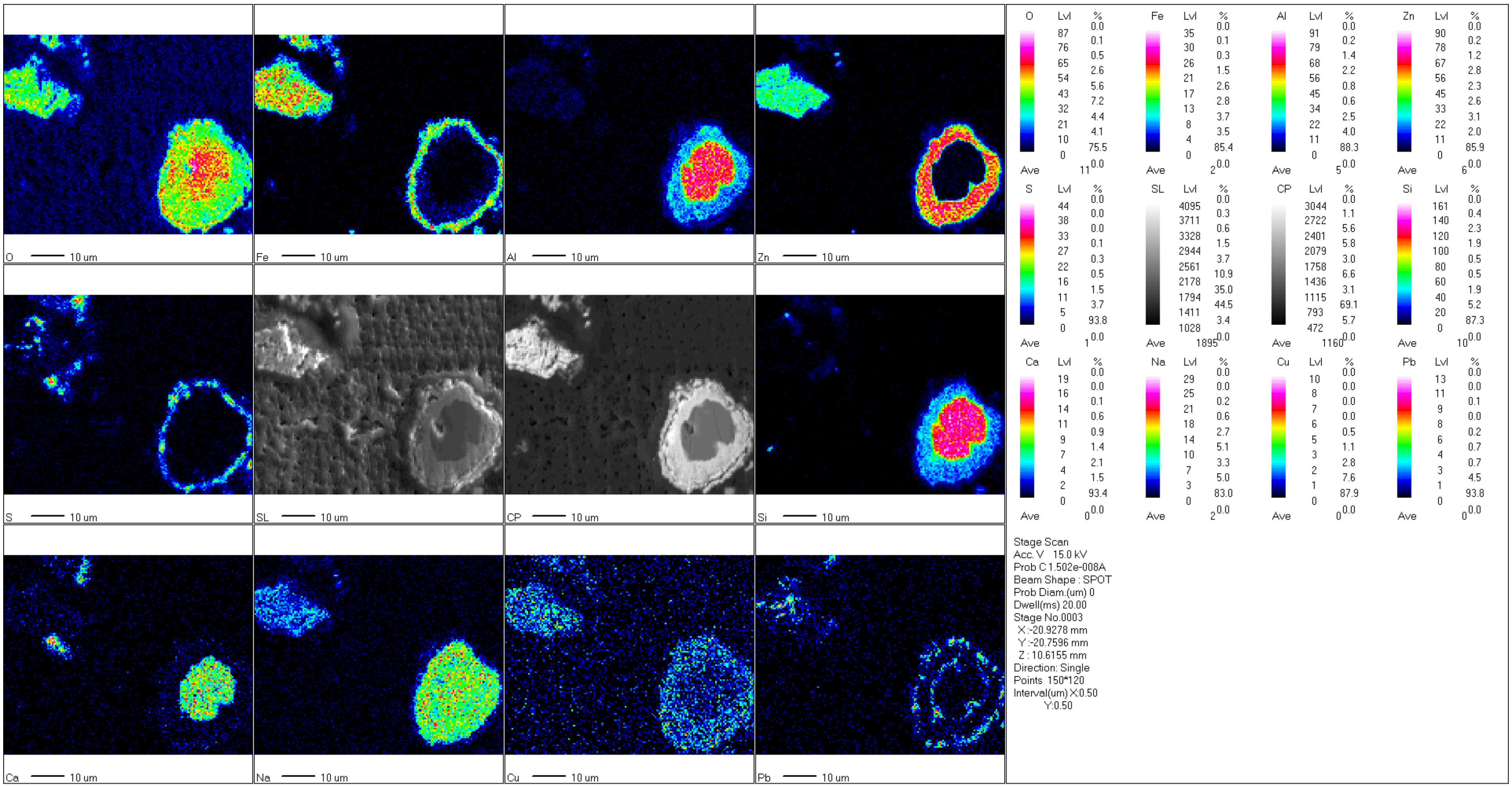

Figure S2: EPMA mapping of the goethite residue

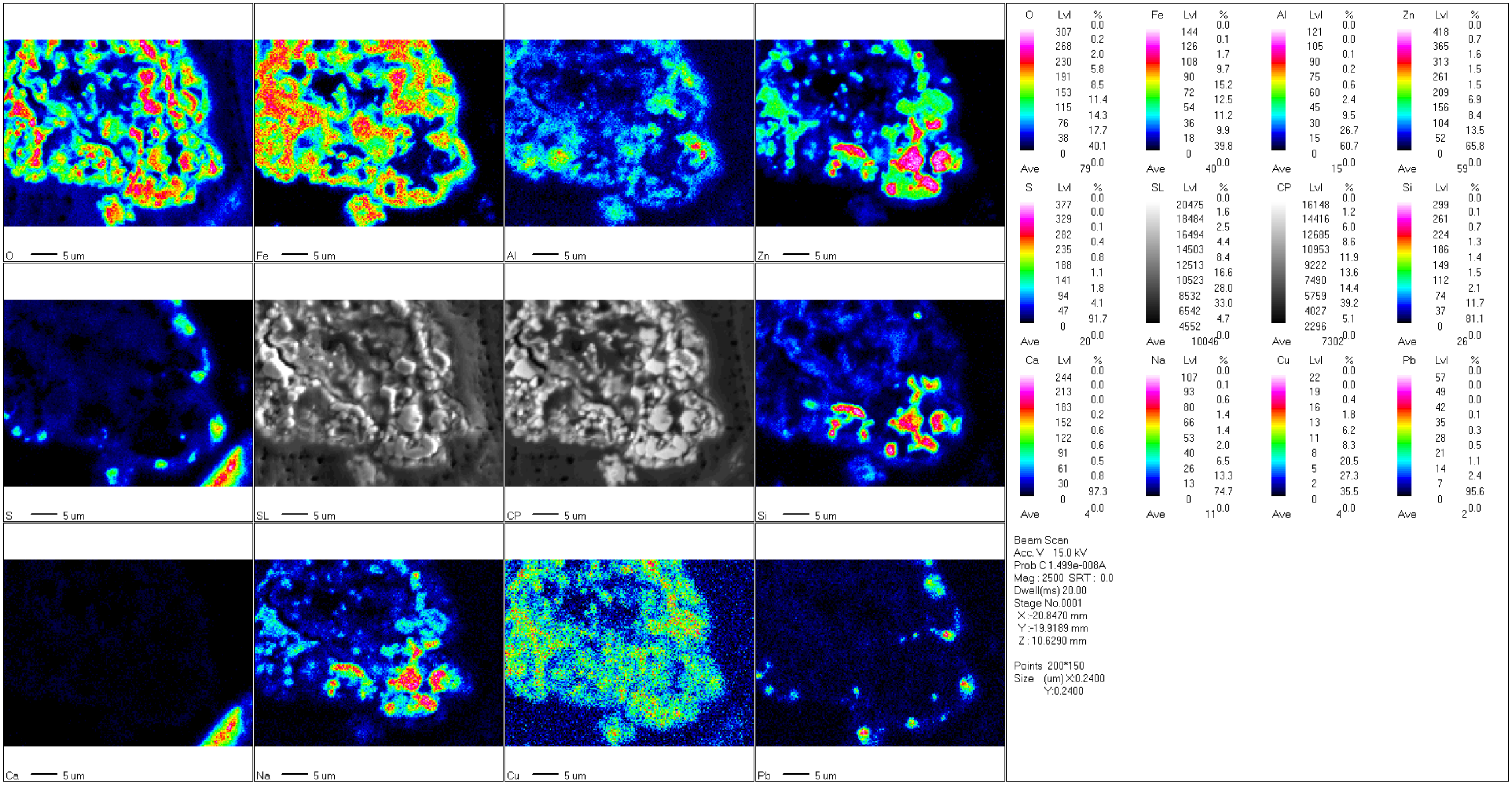

Figure S3: EPMA mapping of the goethite residue

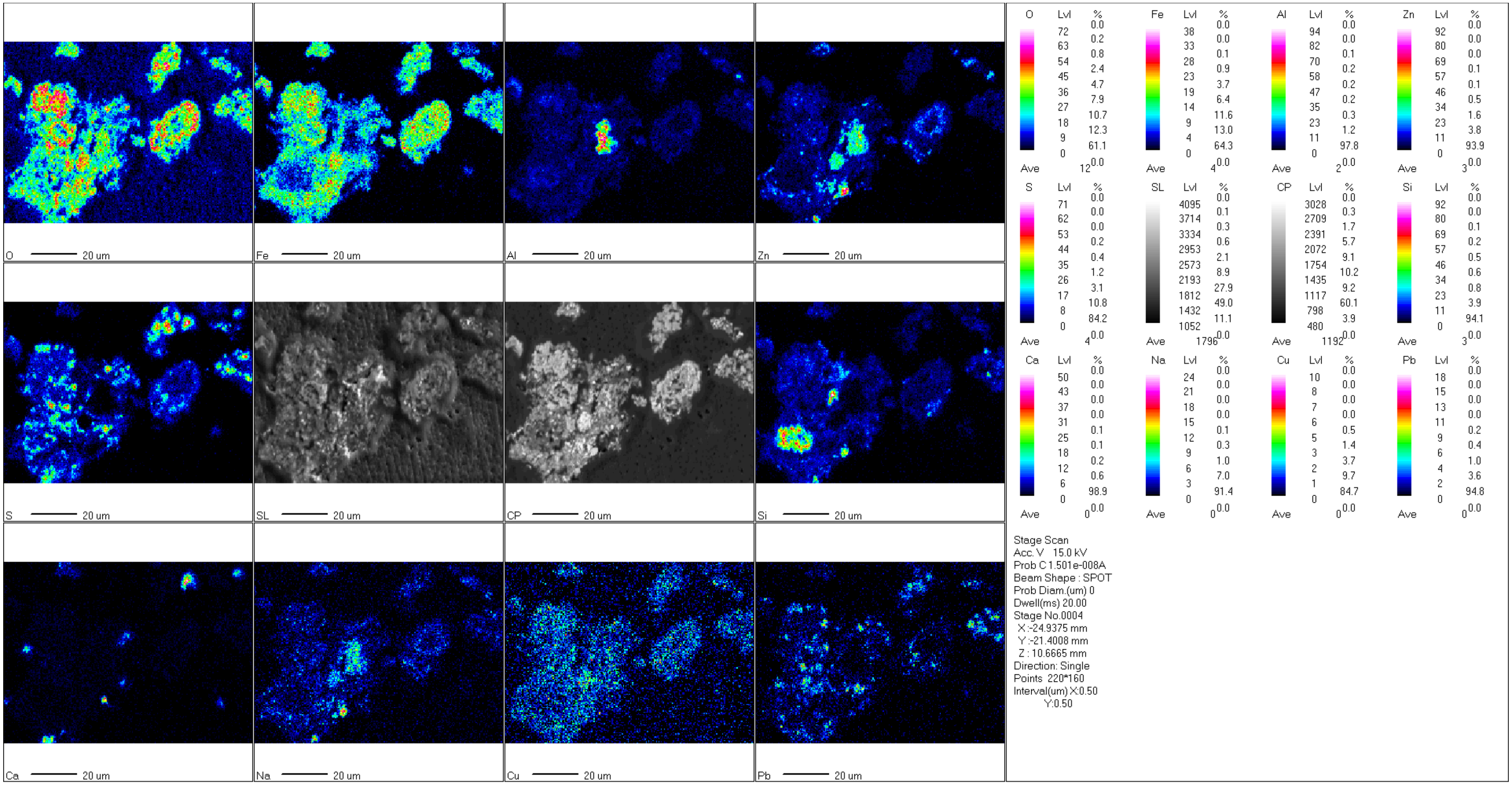

Figure S4: EPMA mapping of the goethite residue

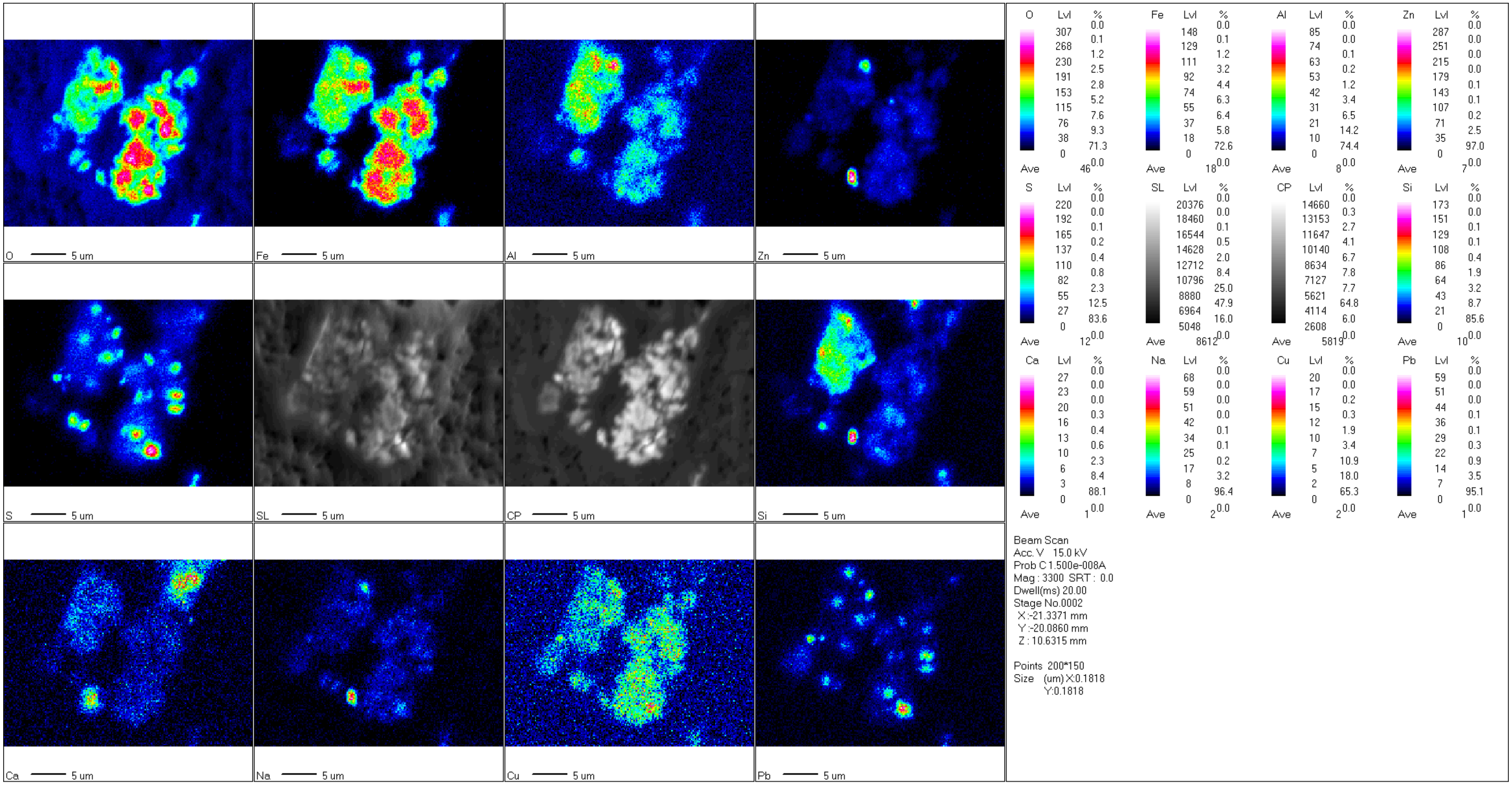

Figure S5: EPMA mapping of the goethite residue

2 Optimization of the leaching process

Table S1: Effect of the temperature on the composition of the pregnant leach solution using LevA-ChCl as lixiviant.[a]

Temperature (°C)	Cu (ppm)	Fe (ppm)	Pb (ppm)	Zn (ppm)	α
30	4	506	107	2186	4.3
40	11	3235	293	3064	0.9
50	12	4233	274	3220	0.8
60	16	6362	347	3809	0.6

[a]Leaching conditions: L/S = 10, t = 24 h, H_2O wt% = 30, 1000 rpm

Table S2: Effect of the L/S on the composition of the pregnant leach solution using LevA:ChCl(2:1) as liviviant.[a]

L/S	Cu (ppm)	Fe (ppm)	Pb (ppm)	Zn (ppm)	α
5	21	4253	473	5888	1.4
10	12	2799	270	3023	1.1
20	7	1297	151	1112	0.9
30	6	596	108	502	0.8
40	4	503	86	358	0.7

[a]Leaching conditions: T = 40 °C, t = 48 h, H_2O wt% = 23, 1000 rpm

Table S3: Effect of the water content of the DES on the composition of the pregnant leach solution using LevA:ChCl(2:1) as lixiviant.[a] Leaching conditions: T = 40 °C, t = 48 h, L/S = 10, 1000rpm.

H_2O (wt%)	Cu (ppm)	Fe (ppm)	Pb (ppm)	Zn (ppm)	α
1	6	416	60	1531	3.7
9	10	1157	183	2934	2.5
17	11	2007	242	3031	1.5
23	12	2799	270	3023	1.1

[a]Leaching conditions: T = 40 °C, t = 48 h, L/S = 10, 1000 rpm

Table S4: Effect of the leaching time on the composition of the pregnant leach solution using LevA:ChCl(2:1) as lixiviant.[a]

t (h)	**Cu (ppm)**	**Fe (ppm)**	**Pb (ppm)**	**Zn (ppm)**	**α**
2	5	765	185	2839	3.7
4	5	1063	189	2829	2.7
6	7	1452	238	2981	2.1
8	10	3017	292	2990	1.0
24	11	3235	293	3064	0.9
32	11	3520	305	3086	0.9

[a]Leaching conditions: T = 40 °C, t = 24 h, H_2O wt% = 30, 1000 rpm