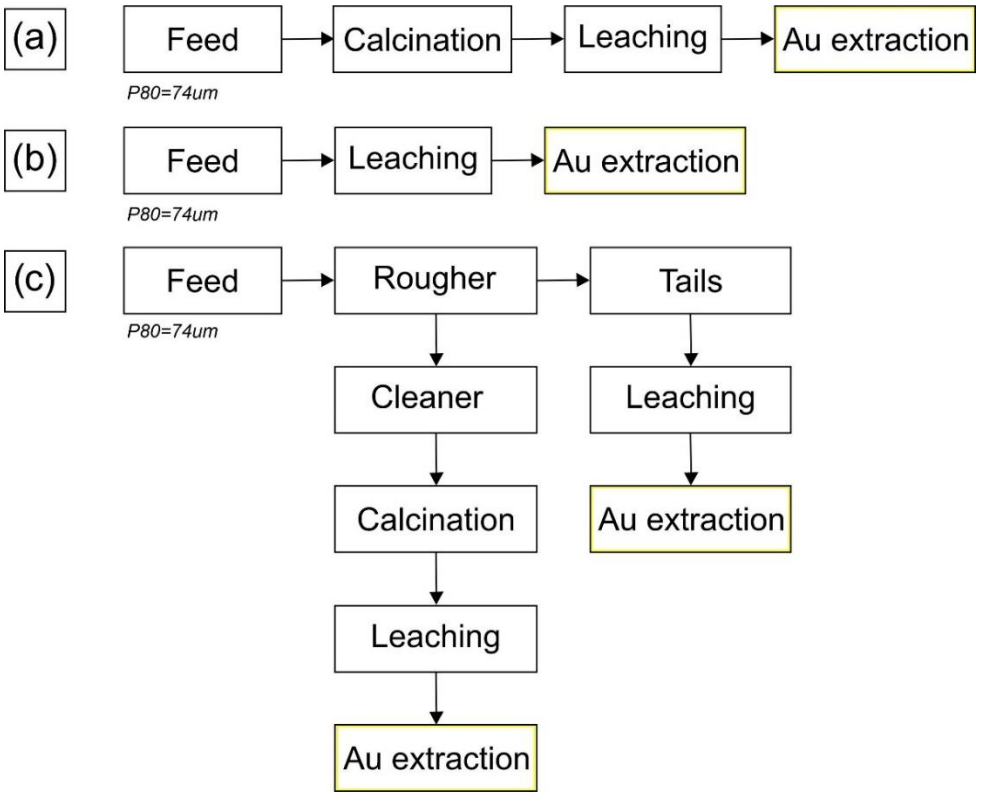


Figure S1. Au extraction potential in (**a**) Calcination + Leaching, (**b**) Direct Leaching and (**c**) Flotation+Calcination+Leaching, modified from [34].

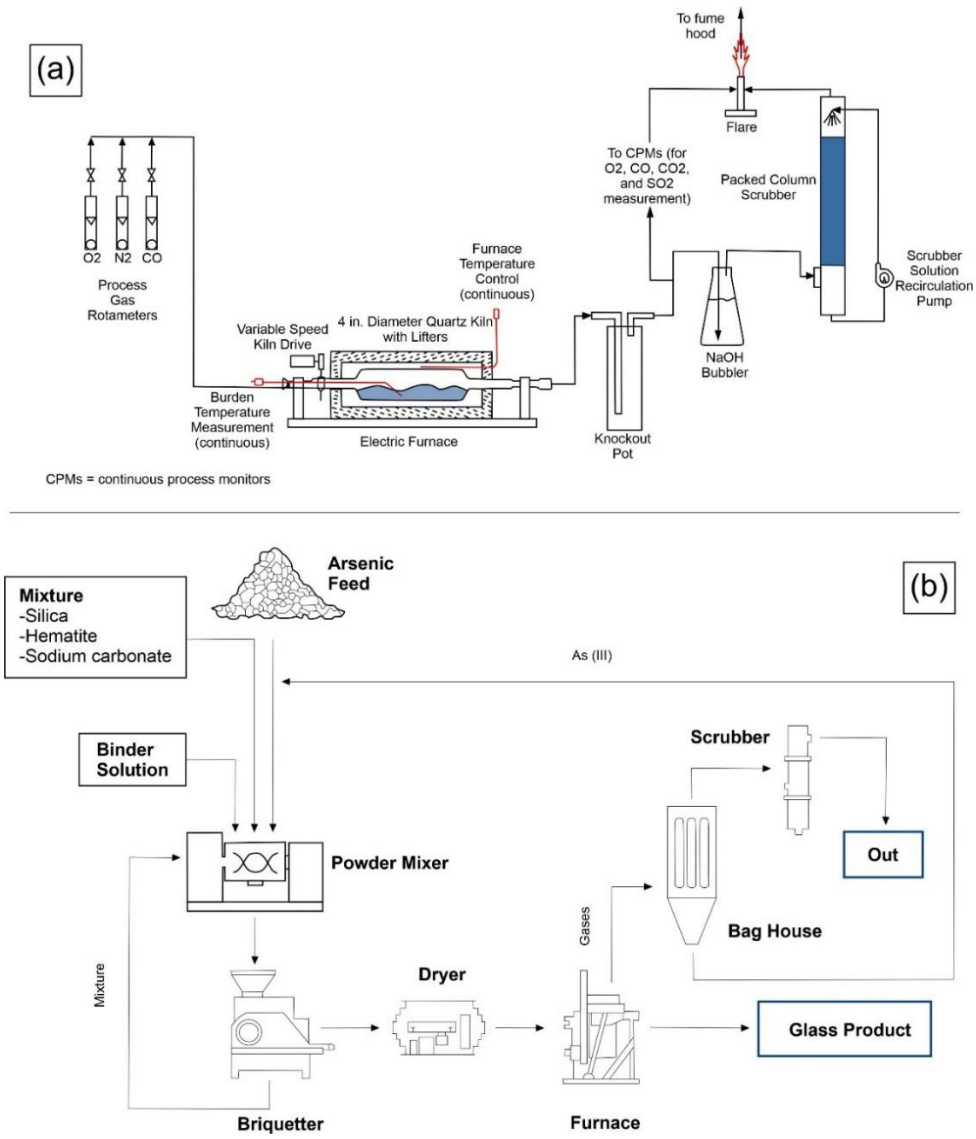


Figure S2. Sb and As extraction potential in (**a**) rotative klin and (**b**) GlassLock™, modified from [11,35].

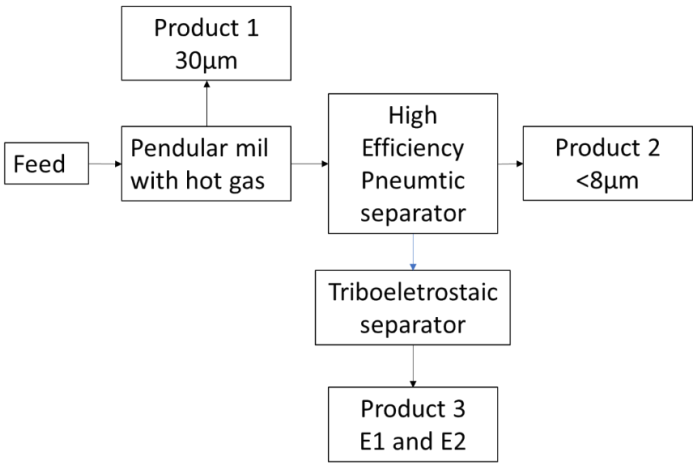


Figure S3. Test flowchart for generation of three potential input-generating products in the civil, fertilizer and other industries.

minerals

MDPI

Table S1. Statistical summary of major elements for the structures' tailings samples.

Structure	N[1]	Element	Mean	SD[2]	Min[3]	Max[4]	N[1]	Element	Mean	SD[2]	Min[3]	Max[4]	N[1]	Element	Mean	SD[2]	Min[3]	Max[4]
BIC	162		1.32	0.4	0.8	2.1	162		1.2	1.64	0.03	4.46	111		1.9	1.07	0.3	3.35
CDS1	175		10	0	10	10	175		0.379	0.923	0.005	10.8	150		0.229	0.349	0.005	3.99
CDS2	293		10	0	10	10	293		3.02	0.613	2.16	6.89	291		1.98	0.264	1.07	2.44
CO	282	Sn	10	0	10	10	282		3.99	1.88	0.02	16	282		2.15	0.879	0.13	3.36
MV	615	(mg/kg)	10.7	4.25	10	40.4	615	Ca (%)	0.244	0.527	0.023	4.19	321	Mg (%)	0.394	0.497	0.007	3.22
ISO	266		9.16	2.8	0	10	266		0.519	0.946	0	4.82	266		0.885	1.21	0	4.23
CA	230		9.93	0.864	0	10	230		2.63	0.686	0	5.75	230		0.593	0.151	0	0.93
BIC	162		0.805	1.69	0	11.8	162		1.53	0.563	0.83	2.82	162		478	221	190	1080
CDS1	150		0.017	0.014	0.005	0.14	150		2.2	0.561	0.005	2.81	150		381	92.6	21	672
CDS2	293		0.785	0.378	0.005	3.93	293		1.7	0.332	0.57	2.3	293		259	47.9	95	350
CO	282		3.47	1.93	0.02	9.47	282		0.617	0.587	0.19	3	282		129	156	35	844
MV	321	S (%)	0.11	0.206	0	1.98	321	K (%)	0.072	0.081	0.007	0.401	321	Ba (mg/kg)	83.6	68.7	3.93	310
ISO	181		3.45	4.5	0	17.7	181		0.953	0.682	0	2.49	181		1091	1238	0	5065
CA	230		1.97	0.704	0	6.33	230		0.912	0.37	0	2.71	230		93.8	39.3	0	339
BIC	111		5.31	4.2	0	21.4	111		0.231	0.1437	0.032	0.494	162		0.116	0.061	0.051	0.262
CDS1	150	Fe (%)	6.86	1.7	4.28	14.3	150	Mn (%)	0.188	0.14	0.05	1.55	150	Ti (%)	0.174	0.224	0.04	1.06
CDS2	293		4.12	2.2	0.86	16.4	293		0.097	0.009	0.08	0.12	257		0.135	0.032	0.07	0.21

CO	282		12.42	2.9	2.42	15	282		0.281	0.067	0.01	0.42	286		0.069	0.037	0.02	0.23
MV	321		0.007	0.007	0	0.08	321		0.094	0.098	0.004	0.65	615		0.019	0.02023	0.001	0.097
ISO	266		17.29	15.4	0	65.6	266		0.163	0.172	0	0.62	266		0.143	0.1	0	0.44
CA	230		42.49	8.91	0	83.3	230		0.097	0.021	0	0.17	230		0.058	0.022	0	0.16
BIC	70		9.24	6.71	0.1	30.5	70		0.04	0.015	0.025	0.095	162		54.5	35	19.3	137
CDS1	150		0.293	0.109	0.05	0.98	150		0.035	0.011	0.02	0.12	150		93.4	39.2	18	273
CDS2	111		2.06	0.281	1.29	3.09	111		0.033	0.004	0.03	0.04	257		21.4	6.22	4	42
CO	248	C (%)	3.55	1.14	0.13	12.1	248	P (%)	0.037	0.014	0.02	0.18	286	Co (mg/kg)	19.6	11.7	4	76
MV	293		2.66	0.071	2.44	3.03	293		0.04	0.021	0.009	0.142	615		34.6	46.2	5.53	361
ISO	133		1.27	2.13	0	15.6	133		0.035	0.022	0	0.11	266		33.1	34.1	0	214
CA	218		0.157	0.113	0	1.29	218		0.046	0.008	0	0.07	230		132	35.8	0	195

[1]N = number of samples; [2]SD = standard deviation; [3]Min – Minimum; [4]Max – Maximum.

Table S2. Statistical summary of trace elements for the structures' tailings samples.

Structure	**N[1]**	**Element**	**Mean**	**SD[2]**	**Min[3]**	**Max[4]**	**N[1]**	**Element**	**Mean**	**SD[2]**	**Min[3]**	**Max[4]**	**N[1]**	**Element**	**Mean**	**SD[2]**	**Min[3]**	**Max[4]**
BIC	162		17.6	7.31	11.1	40.7	162		27.2	25.9	7.9	113	162		116	89.7	11	236
CDS1	175		36.7	15	10	81	150		29.9	9.42	11	61	150		97.8	42.2	1.5	393
CDS2	293		14.5	5.78	10	35	293		23.5	5.73	5	34	293		137	36.2	101	386
CO	282	La	13.8	32.6	10	489	282	Li	6.34	4.37	1.5	21	282	Sr (mg/kg)	83.2	100	12	1040
MV	615	(mg/kg)	17	13.6	10	79.1	321	(mg/kg)	8.54	14.8	1.5	88	321		20.4	22.4	10	117
ISO	266		17.9	20.4	0	124	181		26.4	21.7	0	79	181		166	152	0	531
CA	230		10.4	2.46	0	22	230		1.69	1.33	0	15	230		94.8	29.2	0	222
BIC	162	W	11.2	4.9	1.9	20.5	111	Se	1.11	0.516	0.5	2	111	Y (mg/kg)	6.94	2.46	4.7	14.6
CDS1	150	(mg/kg)	10.1	0.898	10	21	150	(mg/kg)	10	0	10	10	150		7.69	2.3	3	27

CDS2	257		19.5	32.1	10	172	293		10	0	10	10	293		6.01	0.745	4	9
CO	286		48	20.5	10	105	282		11	10.9	10	158	282		5.09	6.47	3	96
MV	615		11.9	12.9	10	114	615		0.05	0	0.05	0.05	615		10.8	16.1	1.5	86
ISO	266		131	334	0	1854	251		9.16	2.8	0	10	251		6.52	4.31	0	21
CA	230		8.75	3.54	0	10	230		9.93	0.864	0	10	230		4.96	1.32	0	8

[1]N = number of samples; [2]SD = standard deviation; [3]Min – Minimum; [4]Max – Maximum

Table S3. Mineralogical composition by XRD of < 2 mm fraction. Mineral abbreviations after [51].

SAMPLE	Qz	Fsp	P	Ms	Tlc	Cb	Kfs	Gbs	Gth	Hem	Py	Po	Ank	Sd	Gp	Apy	Au
BIC	30	4	8	43	-	3	8	3	tr								
CDS1	22	4	6	60	-	-	5	-	3	-	-	-	-	-	-	-	-
CDS2	45	2	2	23	-	-	19	1	6	-	-	-	-	-	-	-	2
CO	13	1	1	18	4	9	23	3	2	-	-	-	14	2	-	-	1
MV	35	12	tr	35	1	1	-	-	3	5	tr	tr	1	-	1	-	-
ISO	12	-	7	5	-	1	5	-	-	-	7	12	30	16	-	5	-
CA	8	-	4	2	-	-	-	-	-	73	-	-	-	-	13	-	-

Qz = Quartz; Fsp = Feldspar; P = Plagioglase, Ms = Muscovite; Tlc = Talc; Cb = Carbonate Mineral; Kfs = K-Feldspar; Gbs = Gibbsite; Gth = Goethite; Hem = Hematite; Py = Pyrite; Po = Pyrrhotite; Ank = Ankerite; Sd = Siderite; Gp = Gypsum; Apy = Arsenopyrite; Au = Gold; tr = trace.

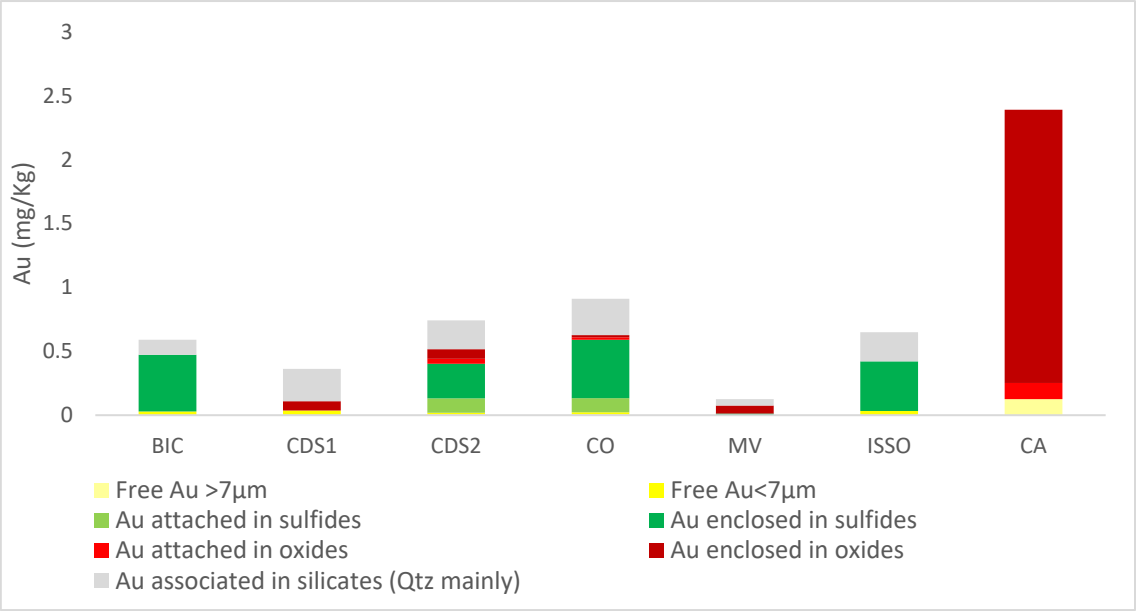


Figure S4. Gold deportment chart by structure complementing Figure 5 of this study.

Table S4. Parameters of each group's centroids, which defined grouping by observations.

Variable	cluster1	cluster2	cluster3	cluster4	cluster5	Global Centroid
Au (ppm)	0.476	2.39	0.742	0.518	0.65	0.824
S (%)	0.411	1.97	0.785	1.790	3.45	1.515
As (%)	0.150	0.72	0.093	0.412	0.72	0.380
Fe (%)	6.085	42.49	4.120	6.213	17.29	12.642
Cu %	0.006	0.09	0.010	0.009	0.04	0.024
Sb (%)	0.006	0.00	0.104	0.001	0.00	0.017
C (%)	4.766	0.16	2.060	3.105	1.27	2.747
Ag (ppm)	0.991	8.49	1.520	1.012	1.37	2.198
Al (%)	5.700	2.87	5.700	2.265	4.75	4.179
Ba (ppm)	429.500	93.80	259.000	106.300	1091.00	359.343
Be (ppm)	1.400	1.49	1.500	1.019	1.37	1.314
Bi (ppm)	5.149	9.93	10.000	5.730	9.16	7.264
Ca (%)	0.789	2.63	3.020	2.117	0.52	1.712
Co (ppm)	73.950	132.00	21.400	27.100	33.10	55.514
Cr (ppm)	310.000	98.30	198.000	139.500	102.00	185.329
K (%)	1.865	0.91	1.700	0.344	0.95	1.141
La (ppm)	27.150	10.40	14.500	15.400	17.90	18.271
Li (ppm)	28.550	1.69	23.500	7.440	26.40	17.653
Mg (%)	1.065	0.59	1.980	1.272	0.89	1.162
Mn (%)	0.210	0.10	0.097	0.188	0.16	0.164
Mo (ppm)	1.297	7.20	1.500	2.145	1.37	2.422
Ni (ppm)	223.500	494.00	129.000	86.850	83.50	189.600
P (%)	0.038	0.05	0.033	0.038	0.04	0.038
Pb (ppm)	107.300	241.00	69.600	38.450	30.00	90.300
Sc (ppm)	19.050	9.30	15.900	6.570	8.31	12.107
Se (ppm)	5.555	9.93	10.000	5.525	9.16	7.321
Sn (ppm)	5.660	9.93	10.000	10.350	9.16	8.730
Sr (ppm)	106.900	94.80	137.000	51.800	166.00	102.171

Th (ppm)	7.090	9.93	10.000	10.000	9.16	9.039
Ti (%)	0.145	0.06	0.135	0.044	0.14	0.102
U (ppm)	5.610	9.93	10.000	10.000	9.16	8.616
V (ppm)	126.500	58.10	87.200	48.950	63.00	79.886
W (ppm)	10.650	8.75	19.500	29.950	131.00	34.350
Y (ppm)	7.315	4.96	6.010	7.945	6.52	6.859
Zn (ppm)	109.200	3213.00	113.000	145.550	94.30	561.400
Zr (ppm)	90.200	16.00	78.100	16.800	51.00	51.300
Mud	9.082	15.62	5.834	11.113	10.48	10.331
Fine Silt	74.935	65.50	50.498	60.365	65.61	64.601
Coarse Silt	12.975	16.14	29.755	22.848	19.01	19.507
Very fina Sand	1.812	2.43	8.923	3.861	3.10	3.685
Fine Sand	0.517	0.23	2.508	0.790	0.74	0.869
Medium Sand	0.600	0.02	2.088	0.835	0.94	0.845
Coarse Sand	0.076	0.03	0.303	0.147	0.10	0.125
Very Coarse Sand	0.004	0.03	0.046	0.026	0.02	0.022
Pyrite	2.670	0.00	0.080	0.280	0.22	0.886
Quartz	32.875	15.60	35.600	46.815	36.65	35.319

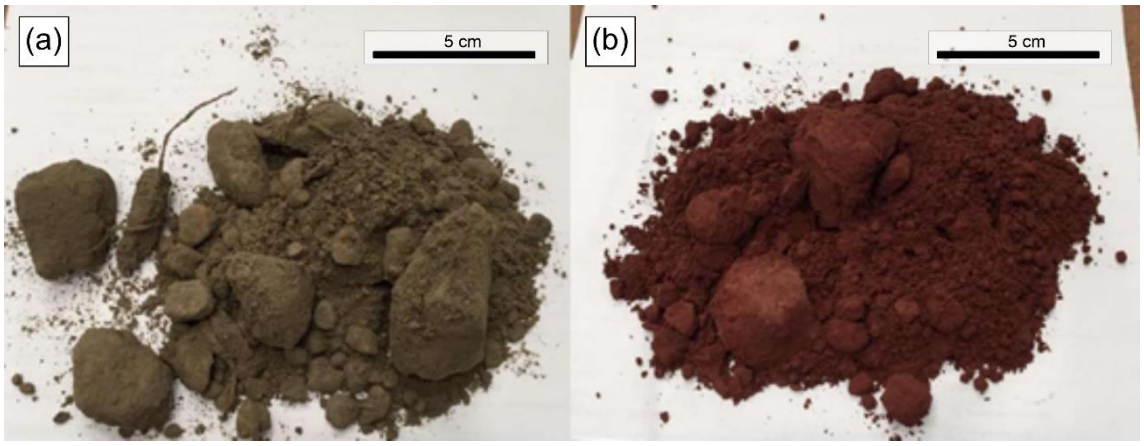


Figure S5. Image of tested samples in the selective grinding test, pneumatic and triboelectrostatic separation from (**a**) Grsoup 4 and (**b**) Group 5.