

Supplementary

Table S1. Mineralogy composition of the ore used for the study (Pn: Penlandite, Ccp: Chalcopyrite, Cub: Cubanite, Po: Pyrrhotite, Py: Pyrite, Hbl: Hornblende, Di: Diopside).

	Pn	Ccp.	Cub	Po	Py	Hbl	Di	Other silicate	Carbonates
Wt.%	0.49	0.60	0.34	1.00	0.74	39.06	35.38	21.30	0.60

Table S2. Chemical composition of the ore. Cu and Ni were analysed in term of sulphide form (S) and total from all form (T).

	Cu (T)	Cu (S)	Ni (T)	Ni (S)	S	Fe	Si	O	Mg	Ca	Al	Cl
Wt.%	0.38	0.22	0.24	0.25	1.3	8.6	19.5	45.7	15.9	6.2	1	0.8

Table S3. Composition of the RW.

Parameter	pH	ORP	DO	SPC	Cl ⁻	SO ₄ ²⁻	S ₂ O ₃ ²⁻	P	K ⁺
Unity		mv/(Ag/(AgCl))	%	(μS/cm)			mg/L		
Value	6.49	214.2	103.1	42.2	2.3	3.2	<L.D	0.03	0.69
Parameter	Ca ²⁺	Co	Cu	Mg ²⁺	Na ⁺	Ni	Fe	S	Si
Unity				mg/l					
Value	2.9	<L.D	<L.D	1.2	1.5	<L.D	0.46	1.1	0.42

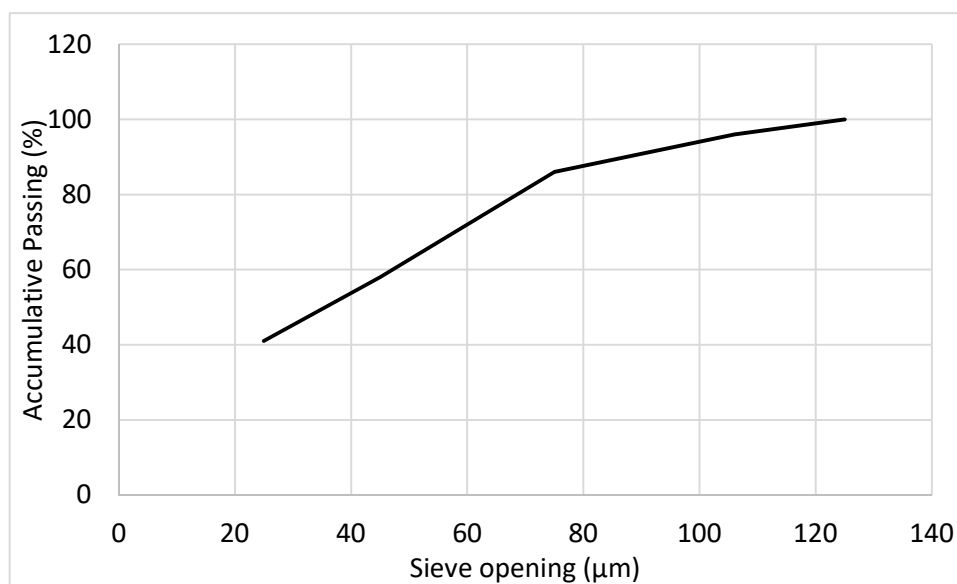


Figure S1. Particle size distribution of the sample after grinding.

Table S4. Analysis methods, Limit of Detection (L.D) and margin of error provided by the contracted laboratories for water analysis.

Parameter	Unity	Methods	L.D	Error %
Ca ²⁺	mg/l	SFS-EN ISO 17294-2 (ICP-MS)	0.05	13%(>500μg/l)
				15%(250-500μg/l)
				25%(<250μg/l)
K ⁺			0.05	12%(>500μg/l)
				15%(250-500μg/l)
				25%(<250μg/l)

Mg²⁺			0.05	12%(>500µg/l) 15%(250-500µg/l) 25%(<250µg/l)
Na⁺			0.05	12%(>500µg/l) 15%(250-500µg/l) 25%(<250µg/l)
total S			0.01	15%(>4000µg/l) 17%(1000-4000µg/l) 20%(100-1000µg/l) 25%(<100µg/l)
Si			0.02	20%(>100µg/l) 25%(<100µg/l)
Co			0.1	15%(>0.2µg/l) 20%(<0.2µg/l)
Cu			0.5	15%(>1µg/l) 25%(<1µg/l)
Ni	µg/l		0.2	15%(>1µg/l) 25%(<1µg/l)
Fe			10	13%(>20µg/l) 20%(<20µg/l)
P			2	15%(>10µg/l) 25%(5-10µg/l) 30%(<5µg/l)
S₂O₃²⁻		SFS-EN ISO 10304-1	5	20 %
SO₄²⁻	mg/l	SFS-EN ISO 10304-1:2009, IC-EC	0.5	12%(<4mg/l) 10%(>4mg/l)
Cl⁻		SFS-EN ISO 10304-1:2009, IC-EC	0.5	10 %

Table S5. The t-test results for comparing means of the pH measured in dissolution loop water (DLW) and the pH observed in the process water (PW).

t-Test: Two-Sample Assuming Unequal Variances		
	pH_DLW	pH_PW
Mean	8.84	7.70
Variance	0.20	0.16
Observations	23	24
Hypothesized Mean Difference	0	
df	44	
t Stat	9.13	
P(T<=t) one-tail	5.147E-12	
t Critical one-tail	1.68	
P(T<=t) two-tail	1.03E-11	
t Critical two-tail	2.02	

Table S6. ANOVA analysis for Cu recovery, Cu grade, Ni Recovery and Ni Grade results from the flotation test with DLW, SW, and PW.

Anova: Single Factor_Cu Recovery						
	<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>	
SUMMARY	DLW	4	245.2	61.3	12.1	
	SW	4	322.9	80.7	9.1	
	PW	4	277.9	69.5	29.5	
ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	762.5	2	381.2	22.5	3.13E-04	4.3
Within Groups	152.2	9	16.9			
Total	914.7	11				
Anova: Single Factor_Cu Grade						
	<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>	
SUMMARY	DLW	4	62.8	15.7	0.2	
	SW	4	34.2	8.6	0.6	
	PW	4	43.1	10.8	0.8	
ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	107.2	2	53.6	101.4	6.73E-07	4.3
Within Groups	4.8	9	0.5			
Total	112.0	11				
Anova: Single Factor_Ni Recovery						
	<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>	
SUMMARY	DLW	4	135.0	33.8	73.4	
	SW	4	46.1	11.5	38.0	
	PW	4	128.0	32.0	73.2	
ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	1222.4	2	611.2	9.9	5.28E-03	4.3
Within Groups	553.9	9	61.5			
Total	1776.3	11				
Anova: Single Factor_Ni grade						
	<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>	
SUMMARY	DLW	4	17.1	4.3	0.1	
	SW	4	13.2	3.3	0.0	
	PW	4	20.3	5.1	0.4	
ANOVA						
<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	6.2	2	3.1	17.1	8.51E-04	4.3
Within Groups	1.6	9	0.2			
Total	7.8	11				