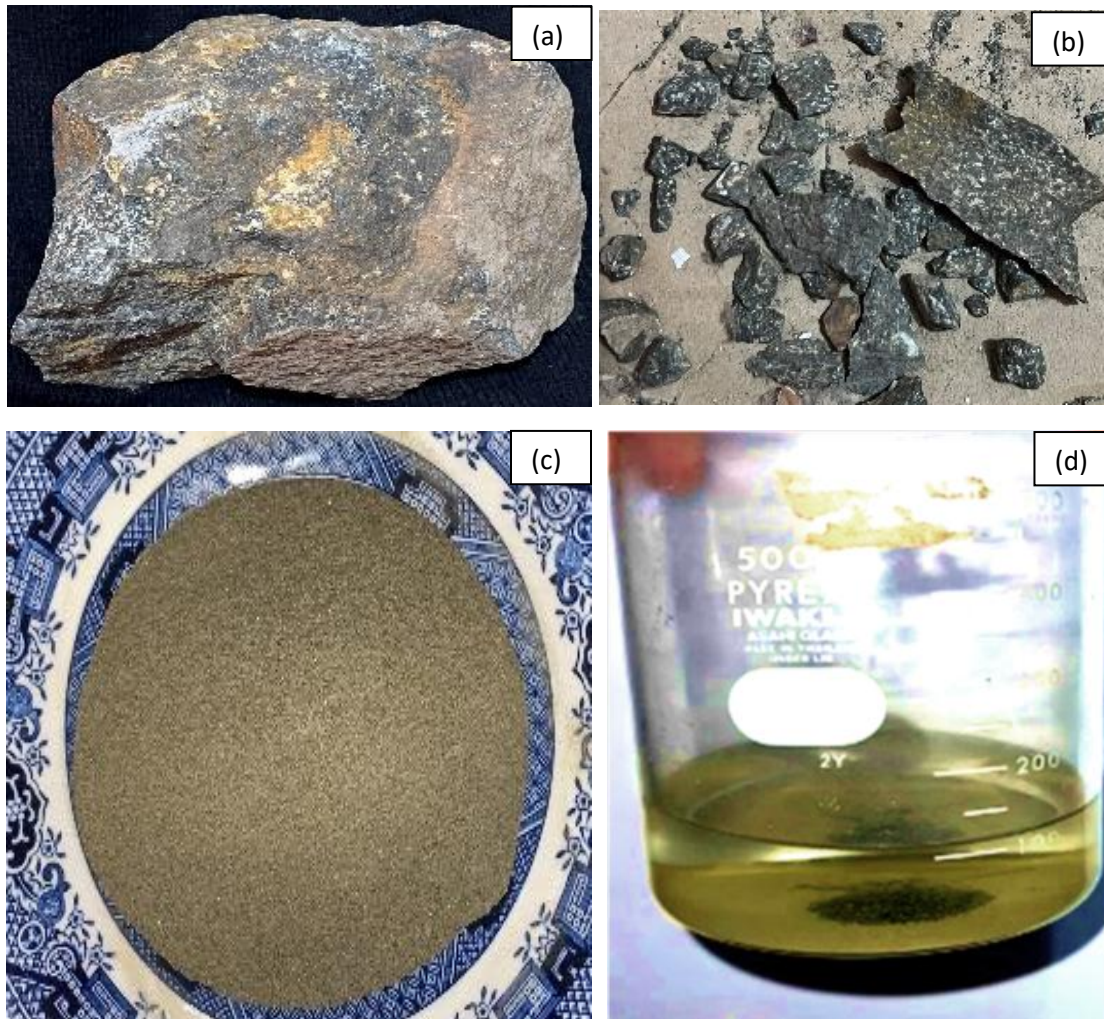


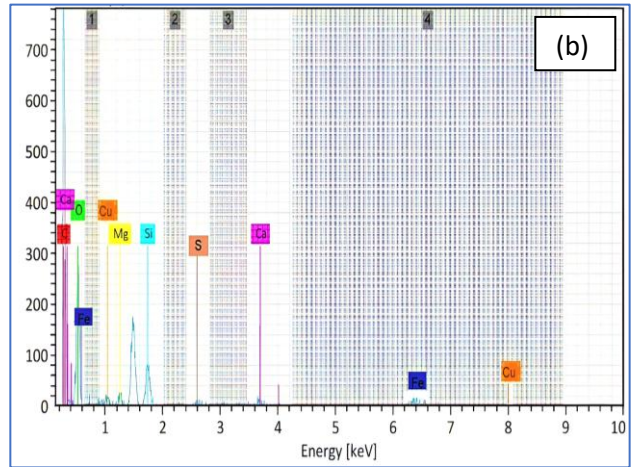
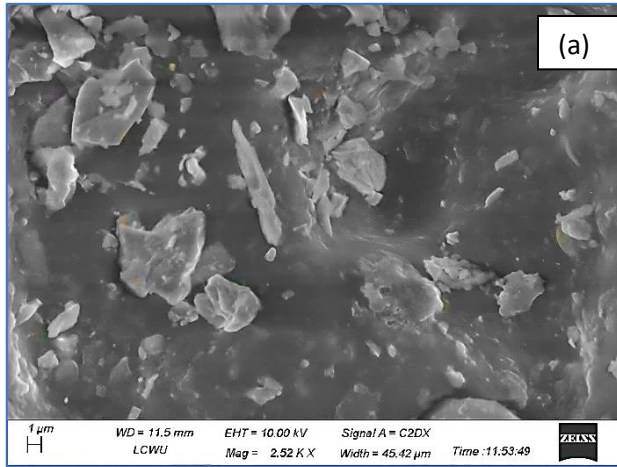
## APPENDIX



**Figure S1.** Low-grade ore sample (a), crushed (b), ground (c), and pregnant leached solution (d) of low-grade ore

**Table S1.** Semi-quantitative analysis of low-grade copper ore sample

Element	At. No.	Mass [%]	Mass Norm [%]	Atom [%]	Rel. error [%] (1 sigma)
Sulphur	16	4.46	4.46	3.97	15.45
Oxygen	8	44.24	44.24	57.89	19.79
Silicon	14	13.73	13.73	12.85	6.62
Copper	29	2.08	2.08	0.72	11.52
Calcium	20	15.86	15.86	9.50	13.99
Magnesium	12	2.62	2.62	2.17	12.86
Iron	26	13.78	13.78	7.31	12.34
Manganese	25	3.23	3.23	0.98	7.67



**Figure S2.** SEM image (a) and EDX spectrum of low-grade copper ore (b)