Supplementary Information

Iron-speciation control of chalcopyrite dissolution from a carbonatite derived concentrate in acidic ferric sulphate media

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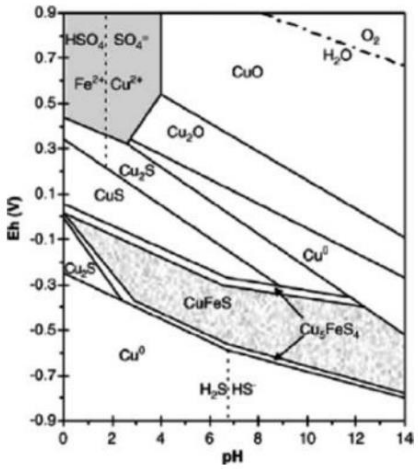
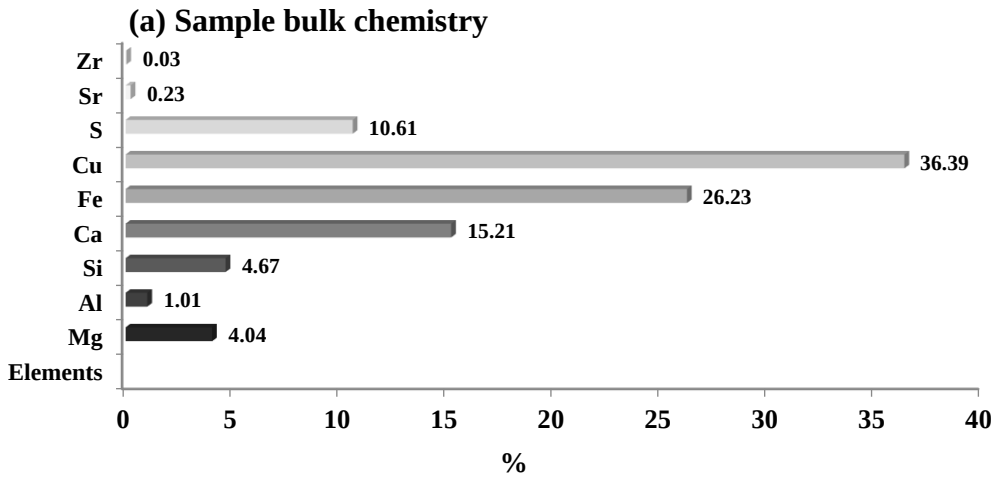
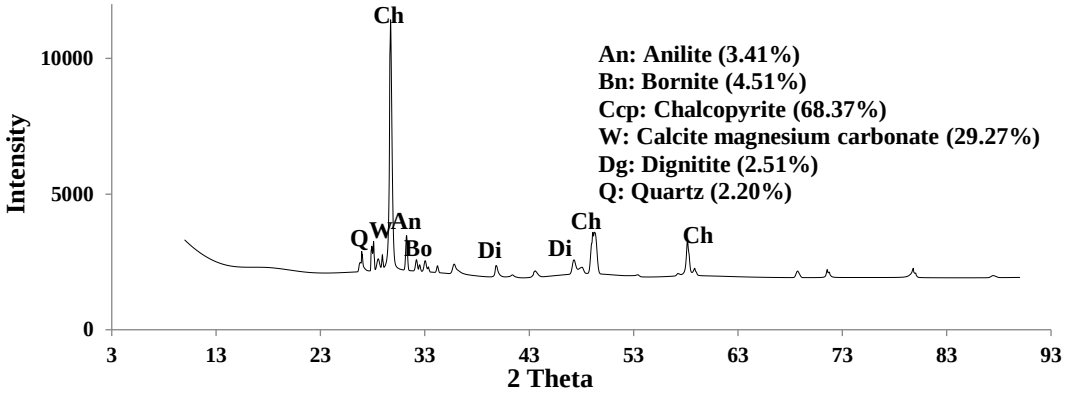
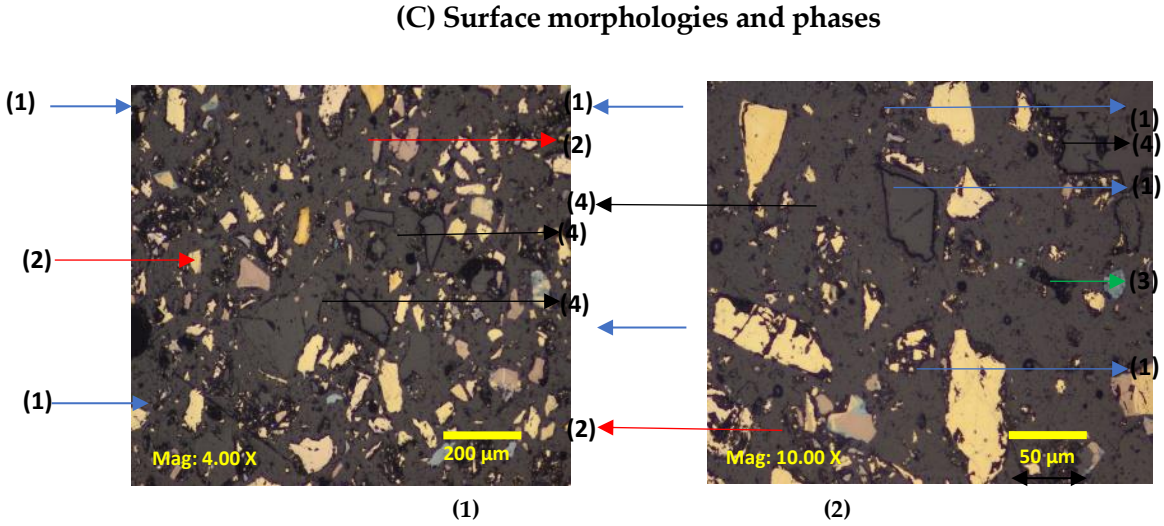


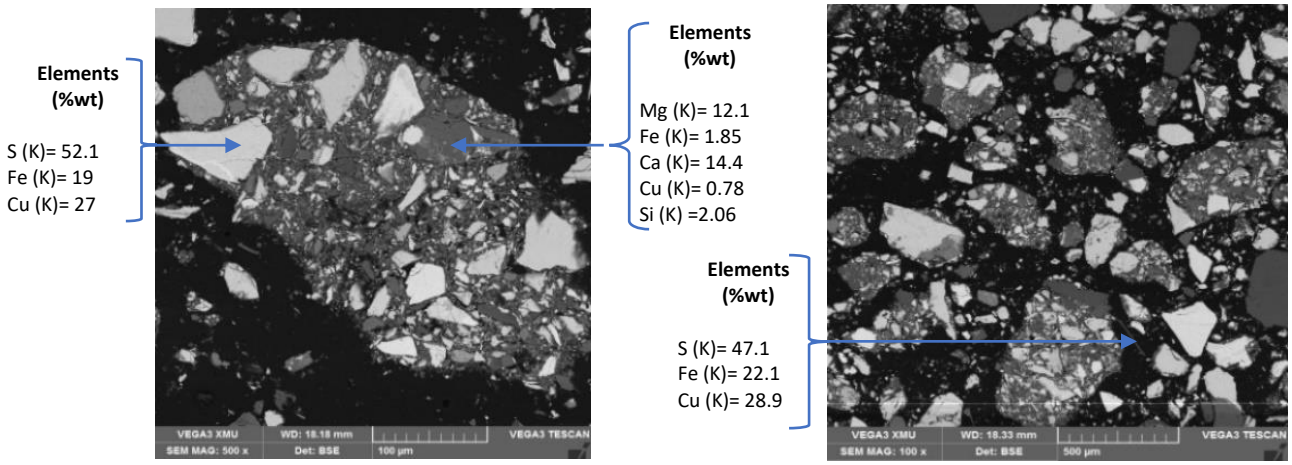
Figure S1: Potential-pH diagram of the Cu-Fe-S-H_2O system [20]







(1): Chacopyrite, (2): bornite (3) digenite and anilite and (4) carbonate



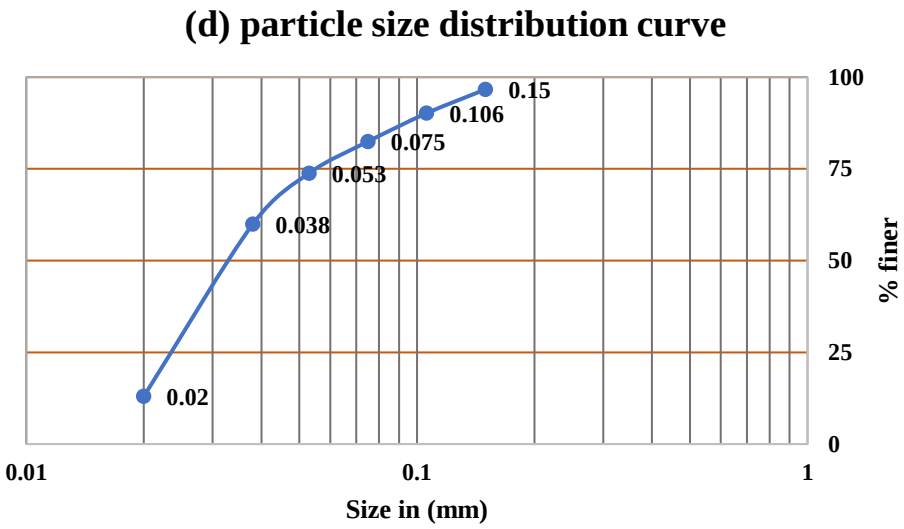
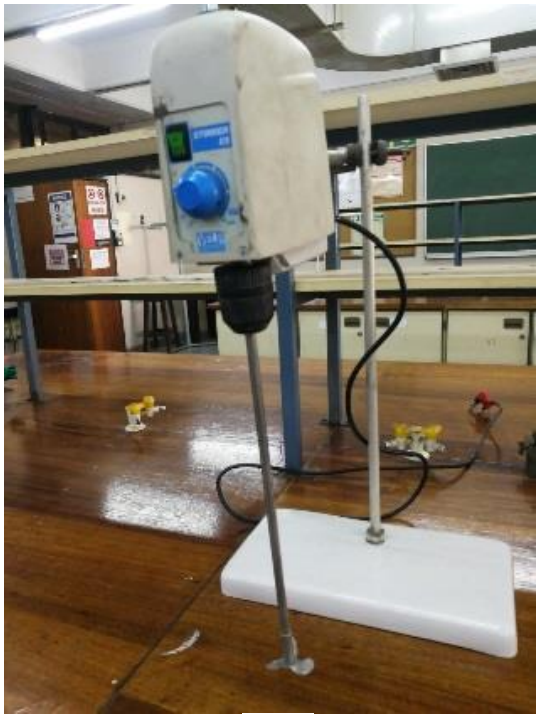
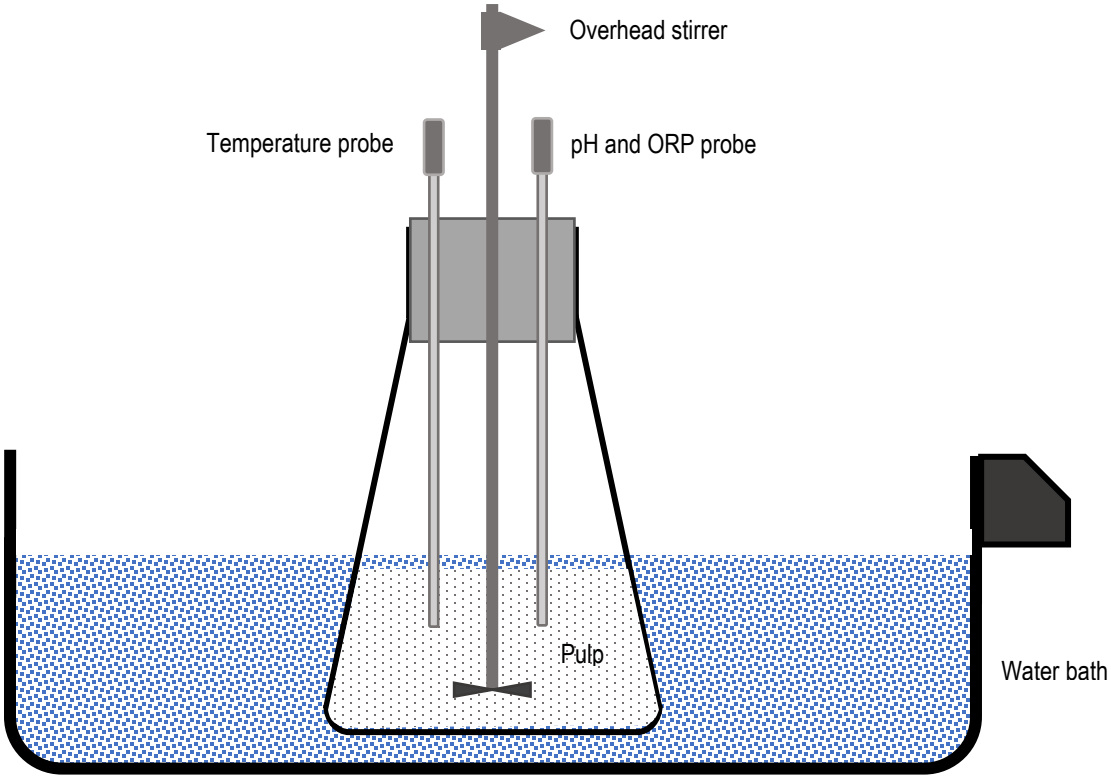


Figure S2. (a) Chalcopyrite bulk chemistry, (b) mineral content (c) grain morphology and (d) particle size distribution: A 200µm screen was first used to remove coarse detrimental debris such as woodchip. The cleaned (screen undersize) CuFeS2 was subjected to a particle size distribution using the following size fractions: −150+106, −106+75, −75+53, −53+38 and −38+20 µm. the sieving results showed that 80% of the CuFeS2 was smaller than 75 µm at an average grain size of 32 µm.



(a)


Overhead stirrer
Temperature probe
pH and ORP probe
Pulp
Water bath

(b)

Figure S3: Set up of the leaching experiment (a) picture of the actual overhead stirrer used in the experiments and (b) the illustration of the apparatus set up.

Table S1. The thermodynamic functions (ΔG° and S°) and the equilibrium constants for the various iron species at 25, 35, 50 and 70°C. Source references. [1] [2] [3]

Formation reaction	**ΔG⁰** (KJ/mol)	**ΔS** (J/mol K)	Log K_f 25 ^{0}C	Log K_f 35 ^{0}C	Log K_f 50 ^{0}C	Log K_f 70 ^{0}C
$H^+ + SO_4^{2-} \rightleftharpoons HSO_4^-$	-756.01	131.80	1.98	2.12	2.32	2.64
$Fe^{2+} + H^+ + SO_4^{2-} \rightleftharpoons FeHSO_4^+$	-841.99	134.19	1.08	1.42	***	2.52
$Fe^{2+} + SO_4^{2-} \rightleftharpoons FeSO_4^0$	-848.67	3.26	2.25	2.33	2.44	2.63
$Fe^{3+} + 2SO_4^{2-} \rightleftharpoons Fe(SO_4)_2^-$	-1524.60	423.16	5.38	6.33	7.64	7.48
$Fe^{3+} + H^+ + SO_4^{2-} \rightleftharpoons Fe(HSO_4)^{2+}$	-775.48	34.97	2.48	2.90	***	4.22
$Fe^{3+} + SO_4^{2-} \rightleftharpoons FeSO_4^+$	784.38	5.93	4.04	4.34	***	5.37
$2Fe^{3+} + 3H_2O \rightleftharpoons Fe_2O_3 + 6H^+$	-742.20	87.40	***	***	***	2.54
Fe^{3+}	-16.70	-280.30	***	***	***	***
Fe^{2+}	-91.20	-107.10	***	***	***	***