Cranfield University

04/10/2022

Teesside site work

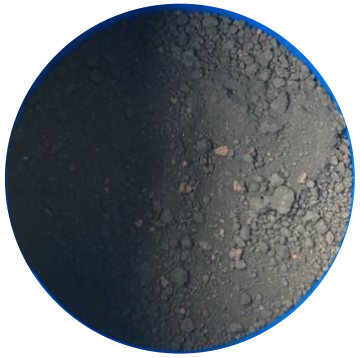
- 17 samples collected from both the surface and sub surface.
- 3 replicates at each location plus 3 replicates given to MPI and BRGM each.

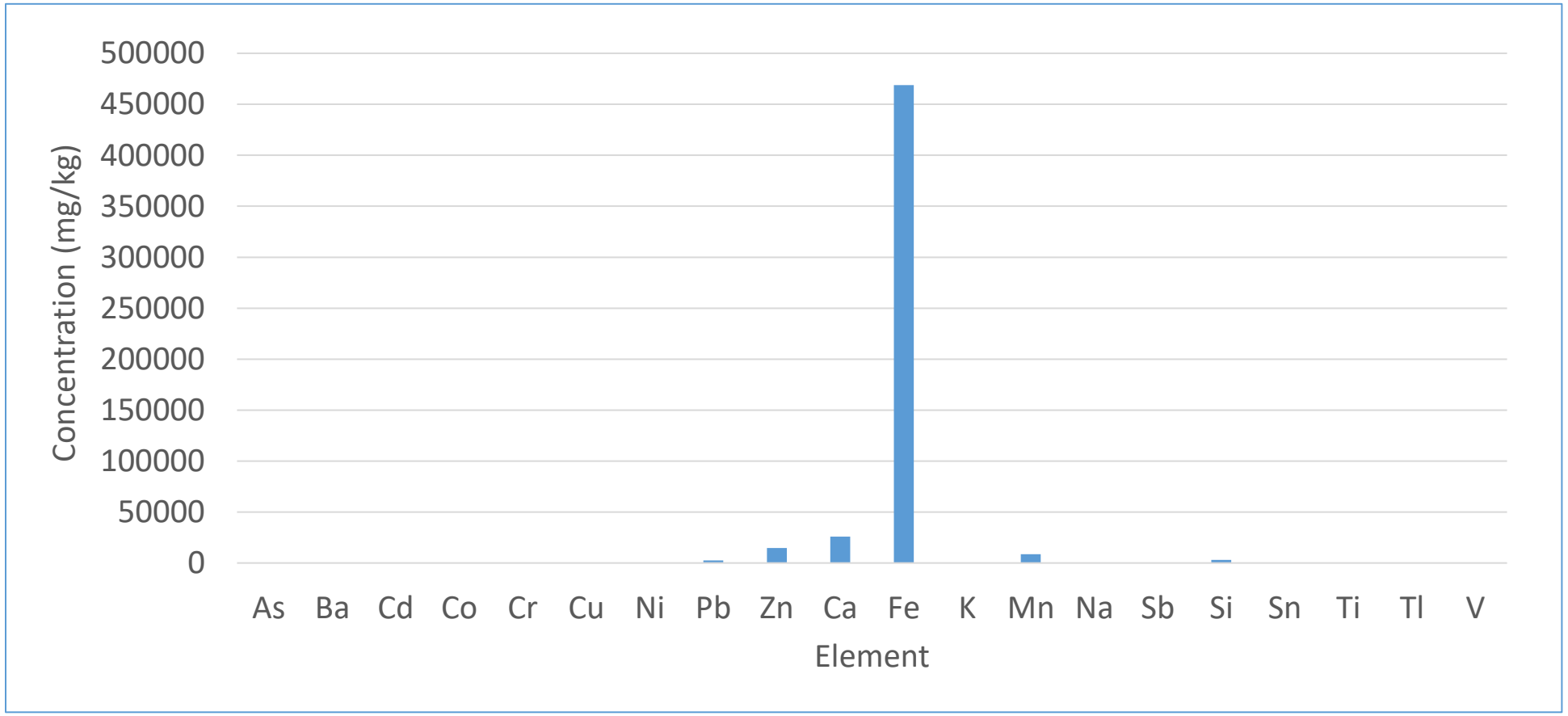
Methods- Teesside samples

- Standard characterisation (moisture, loss-on-ignition, pH etc)
- Handheld XRF analysis for rapid metal content assessment
- Microbial optimisation
- Column testing (pending)

- Presented at SUM 2022 and under review in Detritus journal

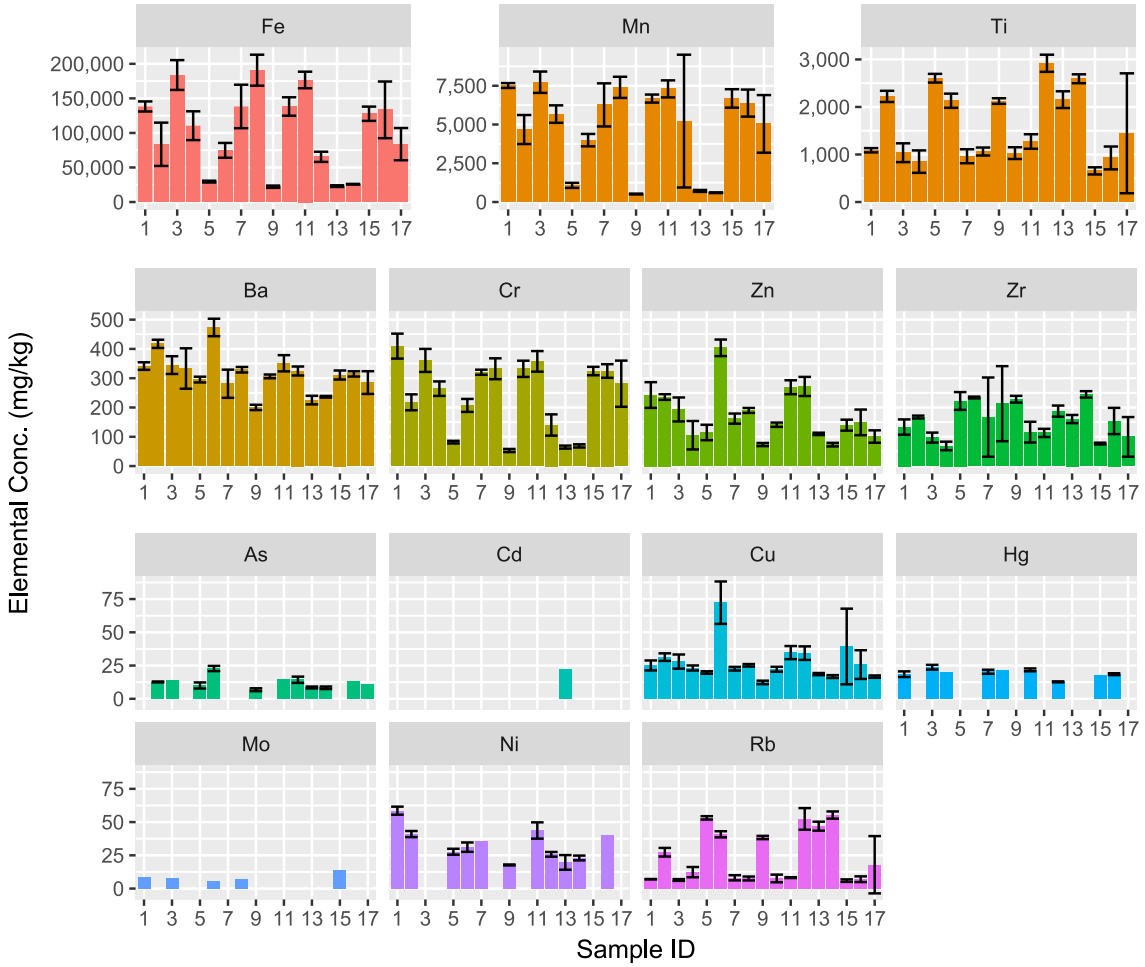
Basic oxygen furnace (BOF) sludge and dust



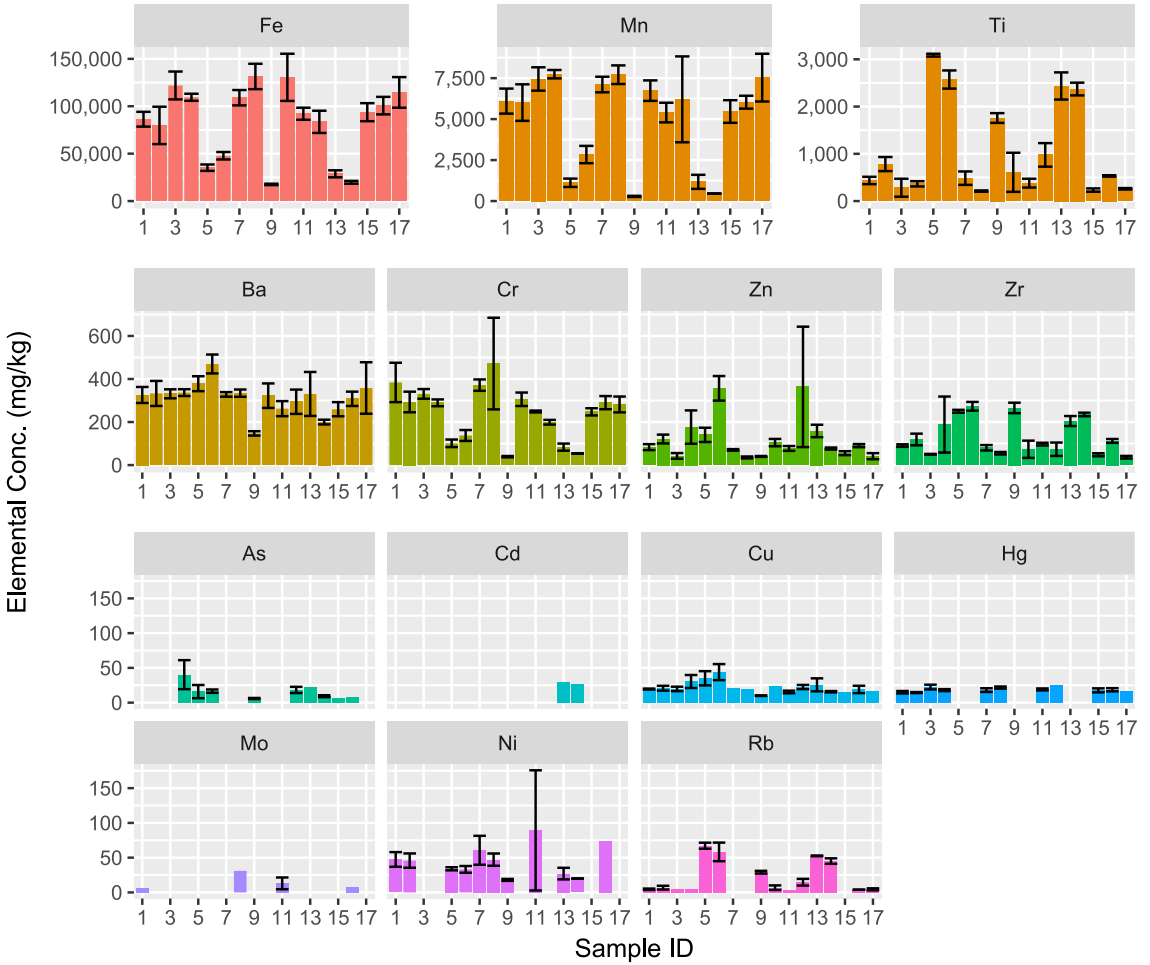


Initial results with pXRF “in-situ”

Surface Samples

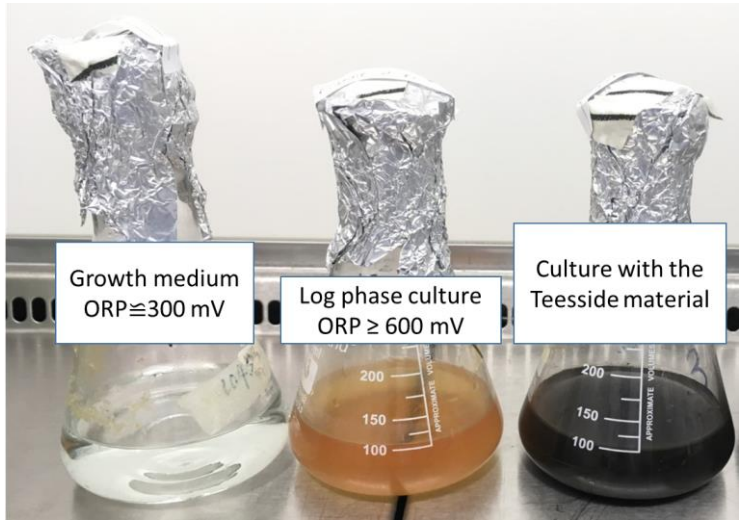


Depth Samples

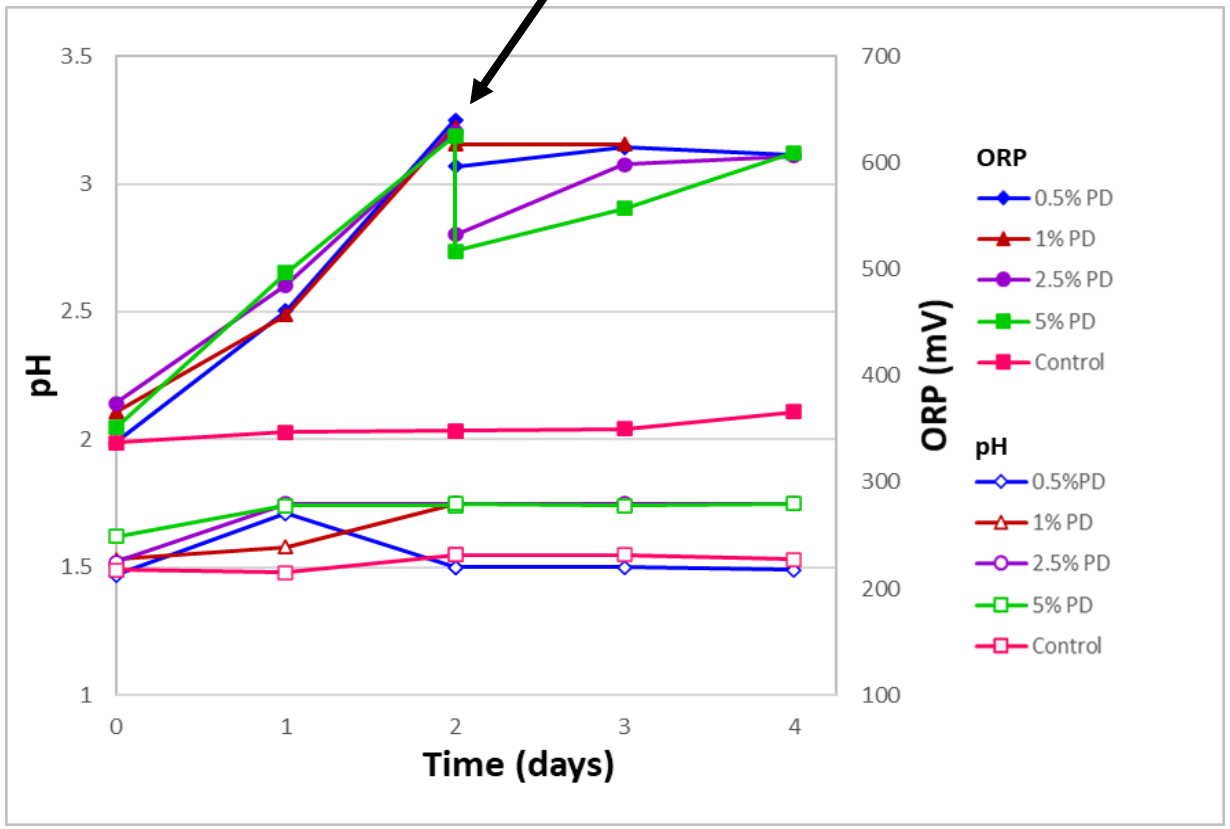


Microbial adaptation study

- BOF material concentration was gradually increased to acclimatise *A. ferrooxidans.*
- When oxidation reduction potential reaches ≥600 mV it is accepted that culture is adapted to current solid concentration.
- *A. ferrooxidans* was adapted up to 5% (w/v) BOF sludge and dust materials.



Sharp decrease was observed in the ORP value after the Teesside material addition



Mean values of the duplicate results

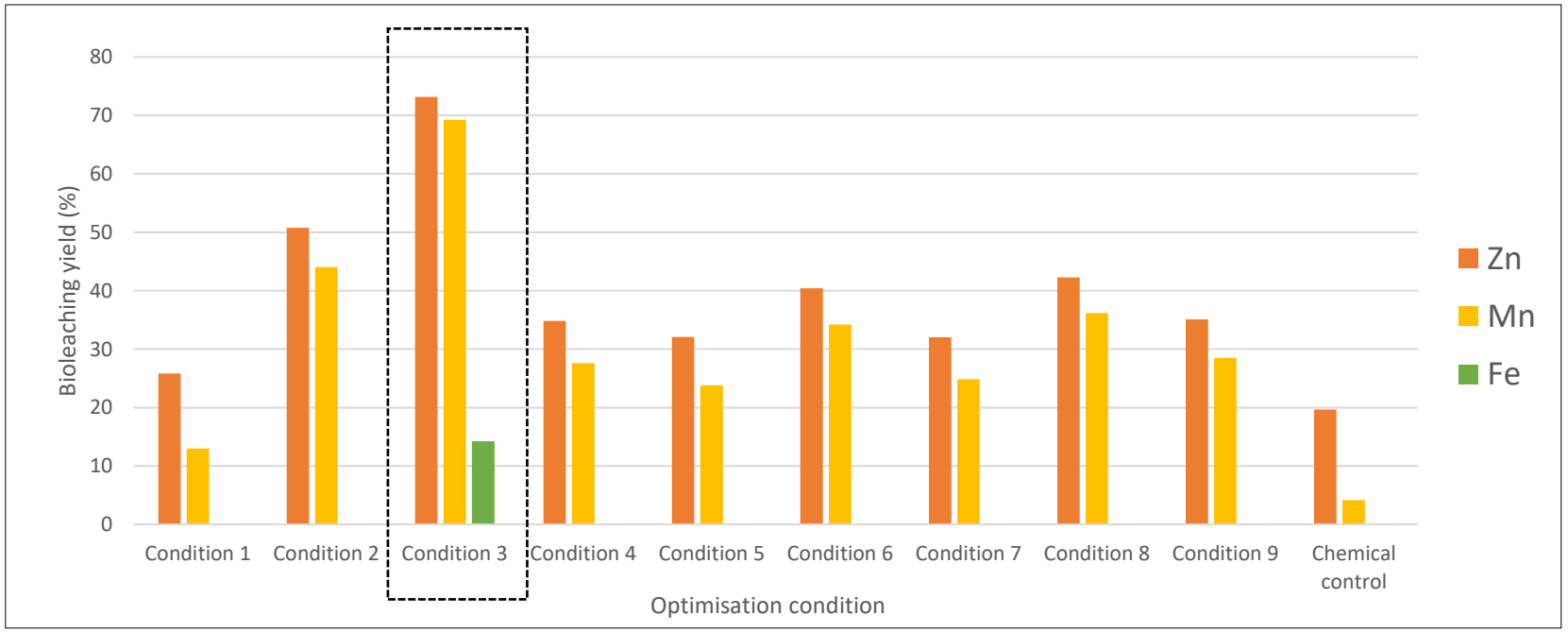
Optimisation results by Taguchi and XRF analysis

pH > energy source conc. > solid conc. > inoculum conc.

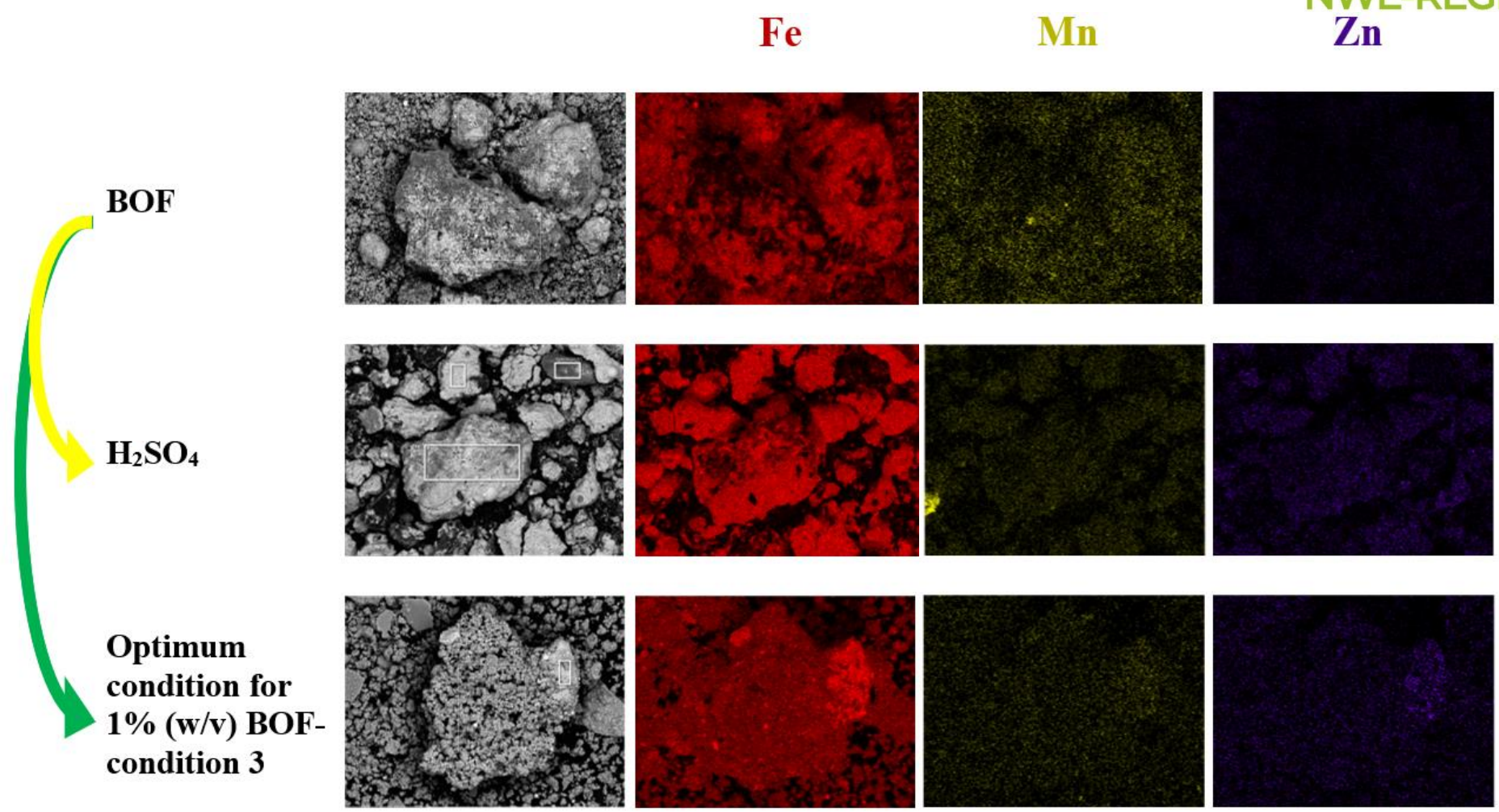
Optimum condition: pH 2, 33 g/L energy source, 1% (w/v) solid conc., 10 % (v/v) inoculum conc.

Bioleaching : 73% Zn, 69% Mn, 14% Fe

Chemical leaching with 5M H_2SO_4 : 20% Zn, 4% Mn, no Fe

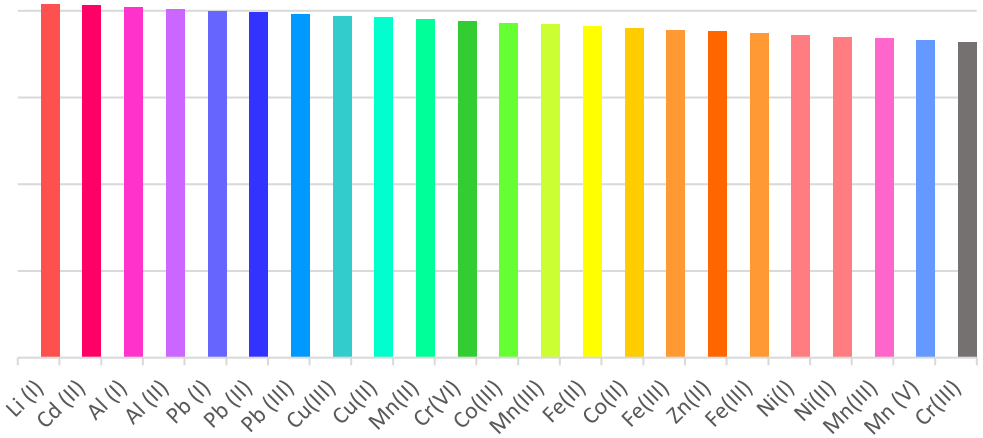


SEM-EDS analysis of BOF bioleaching residues

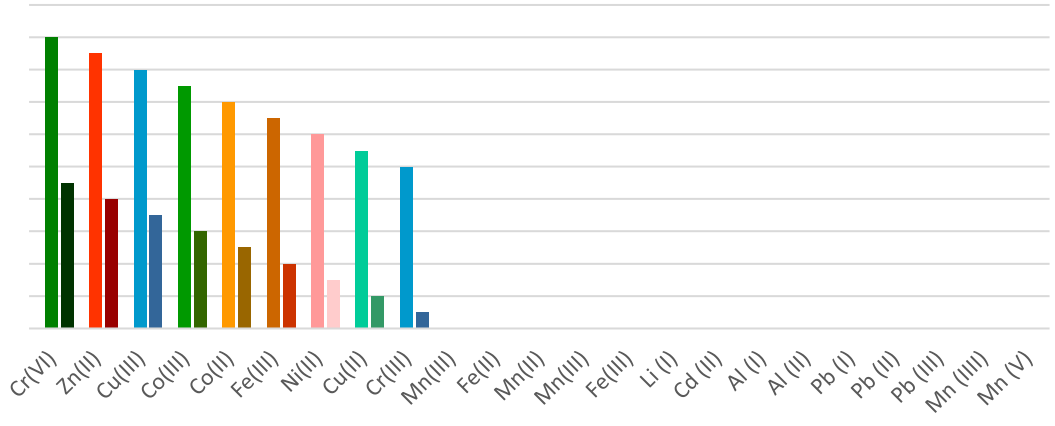


Chemical leaching predictions

ChCl – Malonic Acid
(2:1 ratio shown)



ChCl – Urea
(1:1 and 1:2 ratios)



Next steps- to test this theory in batch and semi-continuous columns (same for bioleaching)

Summary

- Initial results pending publication in the Detritus journal and presented at SUM 2022 conference
- Optimal conditions: pH 2, energy source = 33 g/L, solid conc. = 1% (w/v) , inoculum conc. = 10 % (v/v)
- Under these conditions, 73% Zn, 69% Mn, 14% Fe were dissolved while only 20% Zn, 4% Mn, and no Fe were dissolved by chemical leaching.
- Chemical and bioleaching will be explored in sequence to maximise recovery of target metals

Credits

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