Polymetallic phytomining of mine tailings from Queensland

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Demand for critical metals

The demand for critical metals is increasing at escalating rates
Demand for critical metals

Cobalt Crunch
Rising demand for cobalt risks supply shocks in the early 2020s, BNEF says

- Passenger EV
- Energy Storage
- Consumer Electronics
- E-Buses
- Other

Source: Bloomberg NEF
Declining ore-grades

The rapid declining ore-grades challenges conventional mining methods and generates more waste material than ever before.
Hyperaccumulator plants

Hyperaccumulators are plants that have the remarkable ability to tolerate and accumulate exceptional concentrations of specific metallic and metalloid elements in their shoots.
Phytomining operations cultivate hyperaccumulator plants on metal-rich soils, followed by:

- Harvesting the biomass
- Incineration to produce a high-grade ‘bio-ore’
- Recovery of targeted metals or pure salts
Economics of phytomining
Phytomining at field-scale
Composition (mg kg\(^{-1}\)) of base metal mine tailings from Central Queensland

<table>
<thead>
<tr>
<th>Site</th>
<th>Cobalt</th>
<th>Zinc</th>
<th>Thallium</th>
<th>Arsenic</th>
<th>Cadmium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mt Isa</td>
<td>1960</td>
<td>10 200</td>
<td>75</td>
<td>1350</td>
<td>40</td>
</tr>
<tr>
<td>Dugald River</td>
<td>35</td>
<td>22 000</td>
<td>30</td>
<td>350</td>
<td>50</td>
</tr>
</tbody>
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- Is there a possibility of using a variety of hyperaccumulator plant species of different elements in polymetallic mining from mine tailings?
- What cropping system will maximise metal uptake?
- How does the polymetallic nature of substrates and eventual bio-ore affect the recovery process?
- How does polymetallic phytomining fit into the circular economy concept?
Model species

A) *Haumaniastrum robertii* (Cobalt: 15 000 mg kg$^{-1}$)

B) *Noccaea caerulescens* (Zinc: 25 000 mg kg$^{-1}$; Cadmium: 1000 mg kg$^{-1}$)

C) *Biscutella laevigata* (Thallium: 15 000 mg kg$^{-1}$)

D) *Pityrogramma calomelanos* (Arsenic: 9000 mg kg$^{-1}$)
Experimental work

Assess growth performance and elemental uptake in the selected species
Experimental work

Test recovery processes of the metals from the harvested biomass
Develop a conceptual framework on the role of polymetallic phytomining in a circular economy
Agromining: Farming for Metals
Extracting Unconventional Resources Using Plants
Thank you

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