



Contribution ID : 217

Type : Poster

Acidophilic iron- and sulfur-oxidizing bacteria driven primary mineral weathering and secondary mineral formation in Fe ore tailings

Thursday, 25 November 2021 18:05 (1)

Direct phytostabilisation of Fe ore tailings is typically unfeasible due to its harsh environment, which includes strongly alkaline pH conditions, deficient available nutrients and organic matter and poor physical structure, hindering microbial and plant colonisation. Eco-engineering Fe ore tailings into a soil-like substrate (or technosol) is an emerging technology to rehabilitate tailings landscapes sustainably, involving a suite of abiotic and biotic inputs (organic matter, functional microorganisms and pioneer plants). However, the extreme alkalinity and the lack of secondary Fe-rich minerals are critical barriers to transforming Fe ore tailings into soil.

Using a microcosm experiment amendment with elemental sulfur (S₀), *Acidithiobacillus ferrooxidans* demonstrated the capacity to generate acid that neutralised alkaline tailings and accelerated primary mineral weathering, i.e., technosol formation. [1] The effects of biological S₀ oxidation on the weathering of alkaline Fe ore tailings were examined using several high-resolution micro-spectroscopic techniques, including synchrotron-based X-ray absorption fine structure spectroscopy (XAFS) and electron microscopy. It is found that: 1) *A. ferrooxidans* inoculum together with S₀ amendment facilitated fast neutralisation of the alkaline Fe ore tailings; 2) *A. ferrooxidans* activities induced Fe-bearing primary mineral (e.g., biotite) weathering and nano-sized secondary mineral (e.g., ferrihydrite and jarosite) formation; 3) the association between bacterial cells and tailing minerals were facilitated by extracellular polymeric substances (EPS). The behaviour and biogeochemical functionality of *A. ferrooxidans* in the tailings provide a fundamental basis for developing bacterial based technologies towards eco-engineering tailings into a soil-like substrate for sustainable mine site rehabilitation.

Level of Expertise

Student

Presenter Gender

Man

Pronouns

He/Him

Which facility did you use for your research

Australian Synchrotron

Students Only - Are you interested in AINSE student funding

Yes

Do you wish to take part in the Student Poster Slam

No

Condition of submission

Yes

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Session Classification : Poster Session

Track Classification : Earth, Environment & Cultural Heritage