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Pioneer plant driven primary mineral weathering and secondary mineral formation in Fe ore tailings

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Eco-engineering tailings into soil-like substrates is an emerging technology to rehabilitate the tailings landscapes. Pioneer plants play an important role in mineral weathering and secondary mineral formation, which are pre-requisites for aggregate formation and pedogenesis in the tailings. The present study aimed to characterise the direct role of pioneer plant roots in tailing mineral weathering and secondary mineral formation in a compartmented cultivation system [1]. It was found that root activities accelerated the weathering of Fe bearing primary minerals (e.g., biotite) via Fe(II) oxidation coupled with Fe(III) and Si dissolution. Numerous nanosized Fe-Si rich amorphous minerals and vermiculite were neo-formed in the tailings subject to rhizosphere activities, as revealed by various micro-spectroscopic analysis. The Fe-Si rich secondary amorphous minerals may have resulted from co-precipitation of dissolved Fe(III) and Si on mineral surfaces under alkaline and circumneutral pH conditions. The roots of Gramineae plant Sorghum spp. developed most extensively in the tailings, leading to more efficient mineral weathering and secondary mineral formation than Halophyte plant Atriplex amnicola and Leguminous plant Acacia chisholmii. Overall, the study has unravelled the pioneer plant role in tailing mineral (biotite dominant) weathering and secondary Fe-Si mineral formation. These findings also indicate that tolerant pioneer plants may act as integral components in designing the eco-engineering processes for soil formation in Fe ore tailings.
References:
[1] Wu, S., Liu, Y., ... & Huang, L. (2021). Rhizosphere Drives Biotite-Like Mineral Weathering and Secondary Fe–Si Mineral Formation in Fe Ore Tailings. ACS Earth and Space Chemistry, 5(3), 618-631.

Level of Expertise

Early Career <5 Years

Presenter Gender

Man

Pronouns

He/Him

Which facility did you use for your research

Australian Synchrotron

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Condition of submission

Yes

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