Plant Biomass Amendment Induced Mineralogical and Geochemical Changes in Magnetite Fe-Ore Tailings

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Eco-engineering of tailings into technosols *in situ* presents a cost-effective alternative to phytostabilization of Fe-ore tailings [1-4], by accelerating mineral weathering and the development of physical and geochemical properties and functions similar to those of natural soils [1-4]. As a proof of concept, the present study aimed to determine if admixing plant biomass (PB) into magnetite Fe-ore tailings under saturated conditions could induce mineralogical and geochemical changes towards soil formation. Magnetite Fe-ore tailings (pH 9.5) was amended with 3% (w/w) PB (Lucerne hay) and native soil microbial communities, then incubated for 68 days in a microcosm study. Microbial growth enhanced by PB addition was visually observed, which activities resulted in a rapid neutralization of porewater pH conditions and elevated concentrations of soluble Mg, K, Fe, Ca, and Si in the porewater. K concentrations, in particular, were significantly elevated, most likely resulted from the weathering of K-rich biotite-like minerals. Evidence of the Fe rich mineral weathering was shown by the presence of secondary Fe-minerals and Fe-organic complexes based on Fe K-edge XAFS analysis. The weathering resulted in eroded morphological surfaces of Fe-bearing minerals in the amended tailings. Further evidence of soil-forming characteristics seen was in the SEM imagery, showing aggregate-like structures formed after PB amendment. The current study has provided initial evidence to confirm the expected priming effects of PB amendment on the coupled mineralogical and geochemical changes of amended Fe-ore tailings, which is the basis for the development of soil-like physicochemical properties and technosol formation to support direct phytostabilization.

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