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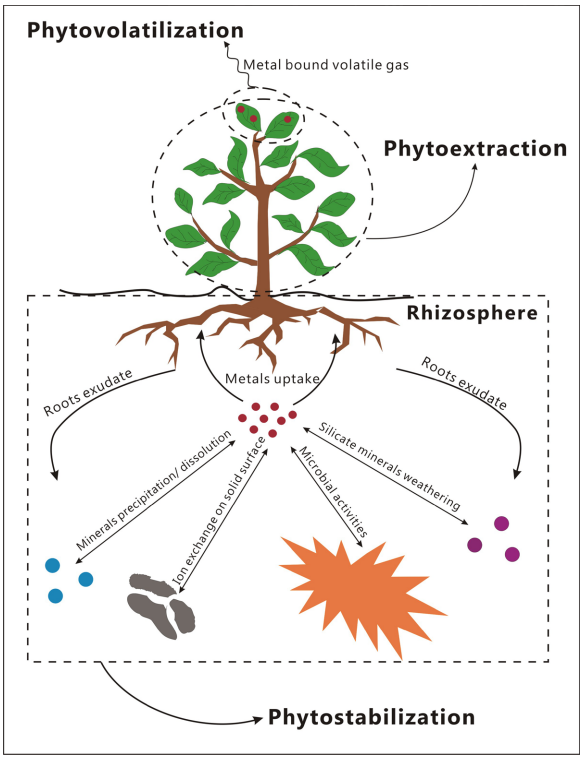
Geochemical processes controlling metals (Pb, Zn) mobility during amended phytostabilization on sulfidic mine tailings

LINA XIE, PHD AND DIRK VAN ZYL

University of British Columbia

Presenting Author: linaxie1992@gmail.com



In the mining industry, tailings is one of the most important mine waste types which always attracts the public's concerns, due to its large volume of potential toxic metals releasing to the environment. Sulfidic mine tailings contain abundant sulfides that are considered highly hazardous to the groundwater and soil environment, because the long-term exposure and oxidation of sulfides is acid generating. Thus reclamation of sulfidic mine tailings is an important way to prevent heavy metals or toxic contaminants from being released to the surrounding environment. Phytostabilization is one technique of phytoreclamation, which aims to stabilize the metals in the rhizosphere through growing plants on amended tailings.

This study focused on how amendments influenced geochemical processes and immobilized metals in the rhizopshere during phytostabilization. The greenhouse experiment was conducted in University of British Columbia in 2021. Bauxite residue, lime and compost were selected to mix with tailings for making six amendments to be the pot soil. Wheatgrass that is a recognized species for phytostabilization was planted and there were two duplicates for each amendment. Drainage samples were collected from seeding to harvesting once per week for total 10 weeks, and then sent to the lab for water chemistry analysis. Mineralogy of the original tailings and pot soils after harvesting was analyzed by XRD. Metals in above ground tissues and roots of plants were also analyzed for assessing phytostabilization efficiency.

Results revealed that metals produced from sulfides oxidation were consistently stabilized mostly in amendment with lime and compost, following the amendment with bauxite residue. Precipitation of secondary minerals and adsorption/desorption onto solid phase surfaces were the main inorganic geochemical processes stabilizing toxic metals [fig.1] [1]. The pH adjustment, Fe/Mn oxides addition and nutrients addition are efficient amendments together to keep plants successfully grow and immobilize metals. This study provided a better understanding of the geochemical processes controlling metals mobility through phytostabilization, and would help decision-making when recovering the mining environment.

[1] Xie, L., & van Zyl, D. (2020). Distinguishing reclamation, revegetation and phytoremediation, and the importance of geochemical processes in the reclamation of sulfidic mine tailings: A review. *Chemosphere*, *252*, 126446.