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Investigation of the feasibility of microbial carbonate precipitation for Cd remediation under environmental stress

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Microbial carbonate precipitation (MCP) is known as an efficient process for the remediation of heavy metals from contaminated soils. In this process, ureolytic bacteria (or named urease-producing bacteria) can be a promising mediator used for the immobilization of heavy metals from biodegradable ions to carbonate form. In previous studies, the authors have developed and validated the ability of the strains isolated from electronic waste (E-waste) soils in the function of carbonate precipitation and identified this biotic precipitation for heavy metal immobilization. In this work, the feasibility of this novel approach for heavy metal remediation under natural environments was investigated, specially ensured the bacteria survival capacity under heavy metal stress. An interdisciplinary study including microchemical (ICP-OES, FTIR, XRD), mineralogical (TG-DTA), microscopic (SEM-EDS and fluorescence images), and molecular biological analysis was engaged in this research to understand the biochemical pathways and their environmental engineering applications. In conclusion, 1) varied tolerance mechanisms were observed to confirm the growing of the bacteria in harsh environments contaminated by heavy metals including S-layer sequestration and carbonate precipitation; 2) the accepted MCP technology was promoted by employing a biochemical composite material (BCM) – herein using corncob powder that immobilized an isolated ureolytic strain to sustain their survivability in extremely heavy metal contaminated soils and enhance their functionality for Cd remediation. The research outputs suggests a potential in-situ utilization of E-waste native microorganisms in MCP-based soil remediation, and a better means for metal bio-recovery and sequestration from the polluted environment.