The Use of Fe-Rich Compost for the Amelioration of As-Contaminated Soils

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Arsenic (As), a biologically harmful metal, occurs in soil as a result of lead-arsenate pesticide application, smelting, and natural occurrence. Human exposure occurs via plant uptake, dust inhalation, soil ingestion, and drinking water consumption. Heavy metal loads in urban storm-water runoff are the second most common source of lake water pollution nationwide [1]. High Fe biosolids can reduce bioavailable soil As by providing sorption sites that presumably include Fe-(hydr)oxide particles and ternary complexes with organic-FeOH functional groups [2][3] [4]. In this study, we determined (1) the adsorption, retention, and stability of As reacted with Fe-compost, (2) the model for As adsorption on iron oxides, and (3) the compost microbial community as a function of Fe content. Plating and real-time PCR showed the impact of the various iron treatments on isolated microbial species. The sustainable methods and tools utilized in this bioremedial approach to rectifying soil contamination will use organic waste, mitigate the impacts of urban development and subsequent metal loading from storm-water runoff, and ultimately improve soil quality.

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Imogolite: An ideal mineralogical substrate for the prebiotic assembly of long polynucleotides?

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Imogolite ($HOSiO_3Al_2(OH)_3$)—a key weathering product of volcanic glass/ash—is unique among clay minerals, having the same diameter (20 Å) and long, flexible, filamentous nature as double-stranded DNA [1, 2], a nanotube structure, and a strong affinity for PO_4^{3-} adsorption, which takes place at positively charged AlOH groups on tube exteriors [2–4]. Here I propose that these chemical/morphological traits make imogolite an interesting candidate substrate for the prebiotic assembly of DNA/RNA (i.e., long polynucleotides), and that the free O^- of each phosphate group along the DNA/RNA backbones could represent relict detachment sites left over after the decoupling of single-stranded DNA/RNA from imogolite (Fig. 1d). New evidence to support this idea comes from the recent synthesis of imogolite/DNA hybrid hydrogels, which seem to form by interactions between AlOH groups on imogolite and phosphate groups in DNA [2]. Authigenic imogolite filaments have recently been found within microbe-sized, alpha-recoil track etch-tunnels at the glass-palagonite interface in submarine glasses (Fig. 1; [1]), and so these C- and P-rich 'abiotic' etch-tunnels are a fascinating new analog geological site to consider for the origin of life on Earth.

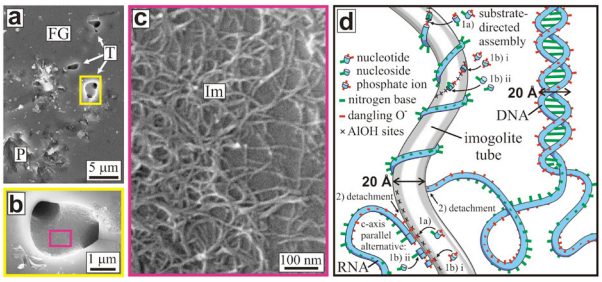

Figure 1: (a–c) SEM images of imogolite and etch-tunnels in DSDP-418A-75-3[120-123] basaltic glass. d) Hypothesis for the prebiotic assembly of DNA/RNA onto imogolite. FG – fresh glass; Im – imogolite; P – palagonite; T – etch-tunnel.

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