Tailings pond mixed species biofilm gives metal precipitates

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Background
Our group has been interested in metal ion resistance and tolerance of bacteria growing as a biofilm compared to that of their free-swimming planktonic state [1]. As expected overall bacteria growing as a biofilm are more tolerant to metals. Recently we have moved from single model species to environmental community isolates. This study utilized the Calgary biofilm device (CBD) as a microscale reactor to cultivate mixed species biofilms directly from Alberta oil sands tailings pond sediments, under a variety of different culture conditions [2]. This approach revealed that the organisms within the biofilms strongly represented the indigenous population in the tailings used as the inoculum and contained over 10 different genera per biofilm including organisms belonging to Pseudomonas, Thauera, Hydrogenophaga, Rhodoferax and Acidovorax [2].

New results
Subsequently we have been challenging these organisms to salts of metals known to be present in the tailings ponds and at other mining sites including Cu, Pb, Cr, V, Ni, Zn, and Sr as well as Ag, due to its strong microbial biocidal activity. We observed that the mixed species biofilms showed higher tolerance to metal ion stress than a single species biofilm [1]. This study demonstrated biogeochemical transformation of several metal ions to precipitates on and within the biofilm community. The highest species biofilms showed higher tolerances to metal ion stress than a strong microbial biocidal activity. We observed that the mixed species biofilms showed higher tolerance to metal ion stress than a monospecie biofilm isolated from the community. The highest species biofilms showed higher tolerances to metal ion stress than a strong microbial biocidal activity. We observed that the mixed species biofilms showed higher tolerance to metal ion stress than a monospecie biofilms isolated from the community. The highest species biofilms showed higher tolerances to metal ion stress than a strong microbial biocidal activity. We observed that the mixed species biofilms showed higher tolerance to metal ion stress than a monospecie biofilms isolated from the community. The highest species biofilms showed higher tolerances to metal ion stress than a strong microbial biocidal activity. We observed that the mixed species biofilms showed higher tolerance to metal ion stress than a monospecie biofilms isolated from the community. The highest species biofilms showed higher tolerances to metal ion stress than a strong microbial biocidal activity. We observed that the mixed species biofilms showed higher tolerance to metal ion stress than a monospecie biofilms isolated from the community. The highest species biofilms showed higher tolerances to metal ion stress than a strong microbial biocidal activity. We observed that the mixed species biofilms showed higher tolerance to metal ion stress than a monospecie biofilms isolated from the community. The highest species biofilms showed higher tolerances to metal ion stress than a strong microbial biocidal activity. We observed that the mixed species biofilms showed higher tolerance to metal ion stress than a monospecie biofilms isolated from the community. The highest species biofilms showed higher tolerances to metal ion stress than a strong microbial biocidal activity. We observed that the mixed species biofilms showed higher tolerance to metal ion stress than a monospecie biofilms isolated from the community. The highest species biofilms showed higher tolerances to metal ion stress than a strong microbial biocidal activity. We observed that the mixed species biofilms showed higher tolerance to metal ion stress than a monospecie biofilms isolated from the community. The highest species biofilms showed higher tolerances to metal ion stress than a strong microbial biocidal activity. We observed that the mixed species biofilms showed higher tolerance to metal ion stress than a monospecie biofilms isolated from the community. The highest species biofilms showed higher tolerances to metal ion stress than a strong microbial biocidal activity. We observed that the mixed species biofilms showed higher tolerance to metal ion stress than a monospecie biofilms isolated from the community. The highest species biofilms showed higher tolerances to metal ion stress than a strong microbial biocidal activity. We observed that the mixed species biofilms showed higher tolerance to metal ion stress than a monospecie biofilms isolated from the community. The highest species biofilms showed higher tolerances to metal ion stress than a strong microbial biocidal activity.

Summary
A process of growing mixed species biofilms directly from environmental samples has been established. This growth method demonstrated biogeochemical transformation of several metal ions to precipitates on and within the biofilm.

Figure 1: Scanning electron microscopy image of biofilm exposed to 1000 mg/L CuSO4. Crystals shown to be Copper by energy dispersive spectrometry.