Preferential adhesion of rough phenotypes to iron oxides from heterogeneous DMRB populations

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The rate of iron oxide reduction by dissimilatory metal-reducing bacteria (DMRB) depends on bacterial adhesion to the mineral surface. Adhesion is governed by physicochemical interactions at the cell-mineral interface. It was shown that adhesion of DMRB, *Shewanella*, to iron oxides is determined by polysaccharide (PS) components of the outer membrane. O-side chains of LPS and capsular PS of smooth strains inhibited bacterial adhesion while rough strains (no PS extending from the surface) adhered well.

TEM and AFM revealed that populations of DMRB such as *Geobacter* and *Shewanella* displayed varying degrees of phenotype heterogeneity in terms of cell surface structure and composition: both rough and smooth cells were present within the same population.

Adhesion of DMRB to different minerals and model substrates was assessed using AFM and fluorescent microscopy. It was found that the mineral surface physicochemical properties determine its selectivity towards certain phenotypes of bacterial cells. Rough phenotypes adhered better to positively charged (e.g., iron oxide) and hydrophobic surfaces, while smooth phenotypes adhered better to hydrophilic surfaces (mica, glass). Moreover, in the case of overall smooth DMRB populations (*S. oneidensis* MR-4 or *S. algae* FC), only rough cells were found on the surface of the iron oxide**.** Such phenotypic plasticity, when a certain amount of adhesive cells is always present in the population, ensures an ecological advantage for DMRB in a variety of subsurface environments.

Epi- and endo-lithic bacterial colonisation of aeolian sandstone on the Colorado Plateau

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Harsh semi-arid environments such as those found on the Colorado Plateau in Southern Utah require unique adaptations of the indigenous life. This study concerns bacterial communities that act as pioneer organisms ultimately allowing exposed sandstone surfaces to be colonised by higher organisms. These bacterial communities interact with the substrate to produce round weathering features termed “pot holes” which support ephemeral life durring the rainy season. The bacteria are typically found, as a black (desiccated) epilithic biofilm that lines the potholes, as a cryptoendolithic biofilm centimeters below the rock surface and, eventually in the thin sediment layers that accumulate at the bottom of some potholes. Growth of these biofilms under oligotrophic conditions has been established through a series of field experiments that involved wetting the potholes with deionized water and monitoring the resulting geochemical activity.

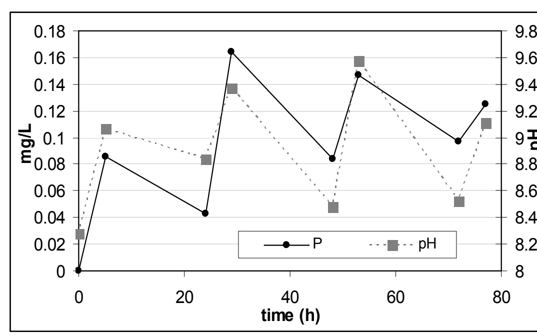

Figure 1: Diurnal cycling of P and pH over 4 days.

The examination of petrographic sections, and the use of high resolution structural techniques, i.e., focused ion beam sectioning FIB-SEM and atomic force microscopy, have demonstrated an intimate association between the biofilms and the arenitic sandstone host, and were used to follow the development of the biofilm when wetted with deionised water.

As the pioneer species, these microbial biofilms serve a terraforming role in this extreme environment where higher organisms, i.e., plants and animals, can eventually survive.