Surface mediated bacteria-mineral interactions: Mineral dissolution and re-precipitation

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Bacteria-mineral interactions represent complex boundaries between two surfaces, one abiotic and the other biotic; comprising the bacterial cell envelope, where metabolic constituents are 'exchanged' in support of energy generation and nutrient acquisition. High-resolution imaging is needed to understand the biogeochemical reactions occurring at the nanometre- (cell wall) to micrometre-scale (when exopolymeric substances and biofilms are involved), because chemistry alone does not allow you to literally look into the microscopic 'black box' to identify, often surprising, mineral dissolution/precipitation processes. The identification of these fundamental, molecular-level processes is essential to understand whether any competing mechanisms exist for the system you're trying to study or optimise, *e.g.,* to identify which components or mechanisms need to be incorporated into kinetic modelling. Examples include: bioleaching processes where passivation 'competes' with mineral dissolution, especially in engineered versus natural systems; supergene copper systems that produce native copper and copper sulphides, unusual redox products for acid weathering environments; to large-scale metal precipitation systems that can produce geological features up to 12 orders of magnitude larger than the initial nano-phase processes responsible for initiating the overall 'reaction', *e.g.,* beachrock formation on Great Barrier Reef islands [1] and the formation of up to 10 m thick, km^2 blankets of goethite resulting from tropical weathering of banded iron formation [2].

[1] McCutcheon *et al*. (2017) *Chemical Geology* 465, 21-34.
[2] Levett *et al*. (2016) *Journal of South American Earth Sciences* 71, 131-142.