

## Minerals and bacteria: Friends or foes?

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Microorganisms have been demonstrated to acquire essential nutrients from dissolving minerals at the Earth's surface and subsurface. There is evidence to suggest that mineral dissolution reactions are accelerated by the presence of heterotrophic bacteria. [1] However, the actual mechanism of microbial accelerated mineral dissolution has yet to be determined.

Dissolution experiments on feldspar and apatite in the presence of *B. megaterium*, a Gram-positive bacterium, were performed to establish the importance of metal uptake by cells, the impact of bacterial exoproducts on dissolution and the significance of bacterial adhesion to the mineral surfaces. Exopolysaccharides (EPS) and bacterial cells accumulated both, Al and Si. Al was rapidly adsorbed on the cell surface while Si accumulation was a slow process which suggests a possible internal uptake or a strong complexation on the cell surface. Exometabolites and EPS were shown to substantially enhance feldspar dissolution especially in conditions of nutrient limitation. The number of cells attaching to feldspar surfaces varied with type of mineral and growth conditions. We found no convincing evidence of enhanced dissolution induced by attached cells. In fact, a series of experiments performed with apatite, indicate that bacteria can accelerate mineral dissolution rates without their physical attachment to the mineral surfaces. The attachment of microbes on apatite crystals is found to actually limit microbial rate enhancement effects.

### Reference

[1] Hutchens, E., Valsami-Jones, E., McEldowney, S., Gaze, W., McLean, J. (2003). *Min. Mag.*, **67**(7), 1157-1170.

## Arsenic mobilization influenced by iron reduction and sulfidogenesis

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Sulfidogenesis and iron reduction are ubiquitous processes that occur in a variety of anaerobic environments that profoundly impact the cycling of arsenic. Of the iron (hydr)oxides, ferrihydrite possesses one of the highest capacities to retain arsenic and is globally distributed within soils and sediments. Upon dissimilatory iron reduction, ferrihydrite may transform to lower surface area minerals, such as goethite and magnetite, which decreases arsenic retention, thus enhancing its transport. Furthermore, interaction of ferrihydrite with dissolved sulfide may result in the dissociation of sorbed arsenic, followed by the repartitioning of As into reduced iron and/or sulfur solid phases. Here we examine the behavior of arsenate (As(V)) and arsenite (As(III)) in column systems containing ferrihydrite coated sand and bacteria capable of iron, sulfur, and/or arsenate reduction.

Greater quantities of pre-sorbed arsenite, rather than arsenate, eluted from abiotic columns during a one month period of time. In contrast, arsenite elution was attenuated in columns during periods of active iron reduction, suggesting the formation of reduced iron-arsenite solid phases within the columns. Furthermore, the abundance of reduced iron phases was diminished in iron reducing columns containing arsenate rather than arsenite, suggesting an As species dependent role in the transformation of iron (hydr)oxides during active iron reduction. Sulfide genesis mobilized arsenic through desorption mechanisms and possibly via the formation of soluble As-S species during the early stages of diagenesis. Progressive development into a sulfide dominated systems results in the repartitioning of arsenic into the solid phase.