Characterising microbial reduction of arsenate sorbed to ferrihydrite and its concurrence with iron reduction

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A series of model anoxic incubations were performed to understand the concurrence between arsenate and ferrihydrite reduction by Shewanella putrefaciens strain CN-32 at different concentrations of arsenate, ferrihydrite and lactate, and with given ΔGrxn for arsenate and ferrihydrite reduction in non-growth conditions. The reduction kinetics of arsenate sorbed to ferrihydrite is predominately controlled by the availability of dissolved arsenate, which is measured by the integral of dissolved arsenate concentrations against incubation time and shown to correlate with the first order rate constants. High lactate concentrations slightly slowed down the rate of arsenate reduction due to the competition with arsenate for microbial contact. Under all experimental conditions, simultaneous arsenate and ferrihydrite reduction occurred following addition of S. putrefaciens inoculums and suggested no apparent competition between these two enzymatic reductions. Ferrous ions released from iron reduction might retard microbial arsenate reduction at high arsenate and ferrihydrite concentrations due to formation of ferrous arsenate. At high arsenate to ferrihydrite ratios, reductive dissolution of ferrihydrite shifted arsenate from sorption to dissolution and hence accelerated arsenate reduction. The interaction between microbial arsenate and ferrihydrite reduction did not correlate with ΔGrxn, but instead was governed by other factors such as geochemical and microbial parameters.
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