Selenate sorption onto bacteria-mineral composites during the progressive addition of Fe(II)

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This study is focused on sorption interactions between microbes, minerals, and metals. Laboratory experiments were done to determine the fate of dissolved selenate (SeO_4^{2-}) and Fe at pH 4 during the addition and oxidation of Fe(II) and the subsequent precipitation of iron oxides in the presence of *Escherichia coli*. The experimental results suggest that selenate does not sorb to *E. coli* surfaces, in addition the presence of selenate does not affect iron oxide precipitation. In fact the presence of bacterial cells appear to influence and delay oxidation of Fe(II) and iron oxide precipitation in a mineral-bacteria composite system. In a composite system the bacterial cells also inhibit selenate adsorption onto iron oxide surfaces. Surface complexation models were used to describe the experimental data. This study is the first to show and provide a detailed understanding of metal oxyanion sorption between bacterial cells and minerals as prior studies have focused on metal cation sorption [1,2,3].

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Retention of selenate at the water-mineral interface in the context of salt dome repositories

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One major process controlling the mobility and bioavailability of selenium, a long-lived fission product found in nuclear waste, is the adsorption onto mineral surfaces of both the engineered and geological barrier. In this context, it is important to understand to what extent this sorption is influenced particularly by characteristic parameters as expected in deep underground repositories for high level and long-lived radioactive waste. These parameters include inter alia the presence of different background salts which are important with regard to salt domes as potential repositories.

In the present study, a combination of macroscopic sorption experiments, electrophoretic mobility and in-situ ATR FT-IR spectroscopy measurements was used to study the interaction of selenate with aged γ-Al_2O_3 in the presence of NaCl and $MgCl_2$. From in-situ ATR FT-IR spectra, a change in the symmetry of the aqueous tetrahedral selenate anion can be derived evidencing the formation of a surface complex on γ-Al_2O_3. From batch experiments, we observe a dependence of selenate sorption on the ionic strength and composition of the electrolyte. Additionally, the sorption generally decreases with increasing pH. However, in the presence of 0.1 M $MgCl_2$, the sorption increased again at a pH above 9.5.

The isoelectric point (pH_{IEP}) of γ-Al_2O_3 is located at pH 9.6 for low NaCl background electrolyte concentration (I = 0.1 M). The increase of ionic strength (up to I = 1 M) results in a decrease of the zeta potential for both the acidic and alkaline pH range. However, in the alkaline range the decrease of the zeta potential is more pronounced. Additionally, we observe that the pH_{IEP} is shifted to more alkaline values and finally no charge reversal is observed. In the presence 0.1 M $MgCl_2$, the surface charge of γ-Al_2O_3 is positive throughout the studied pH range (3-11). Above pH 10, a sharp potential decrease occurs due to $Mg(OH)_2$ precipitation. The impact of the varied parameters on the sorption of selenate in the alkaline pH range will be verified in detail.

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