Impact of bacterial biofilm on alteration kinetics

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Microbial cells, mainly in the form of biofilms, are widespread in soils (up to 10^{10} cells per gram of soil). These microorganisms are likely to influence weathering, particularly in alluvial plain regions [1]. However, very few studies have been carried out to characterize such biological impact, and particularly few taking into account the role of the structure and nature of biofilms on this process. In this study, three bacterial mutants of *Escherichia coli* MG1655 and 1094 with similar metabolism but forming extracellular polymeric substances (EPS) conferring different chemical and physical properties to the biofilm (*i.e.* permeability, functional groups density) were used. The bacteria were incubated in triplicates during 7, 30 and 60 days with different alluvial plain sediments from Varzea de Curuai (Brazil) or with pure minerals (*i.e.* olivine, apatite, calcite), both in the presence or absence of O_2. Simultaneously, control abiotic experiments were also conducted. In order to trace element relase to the solution, the evolution of the chemical composition of the supernatant was monitored using ICP-MS.

Two major effects were observed. First, *E. coli* biofilms have a strong impact on mineral dissolution rates. While some elements are released in the same way as under abiotic conditions, many others elements are sensitive to the presence of a biofilm (*i.e.* Cr, Cu, V, Co, Mo, Ba, Mn, Li, Al, Ni). Major differences between oxic and anoxic conditions were also detected. Second, the structure and composition of the biofilm has a reproductible influence on element release. Since the three mutants have comparable metabolism, the influencing parameters are therefore the biofilm properties. This may include (1) the thickness, porosity and permeability of the biofilm, which allows for differential transport of elements from the mineral substrate to the supernatant; (2) the functionalization of the EPS constituting the biofilm, having variable affinities with certain elements.

[1] Bouchez et al. Chemical Geology, 332-333 :166–184, 2012.