A biophysicochemical approach for assessing the dynamics of metal biouptake at microbial interfaces

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Understanding the toxic and essential trace compounds uptake by microorganisms under conditions relevant to natural environment is a major trigger of concern in environmental risk assessments. While toxicity assays are well documented in numerous studies where exposed ambient concentrations of metals are related to toxicology endpoints such as mortality or growth rate, predicting metal toxicity with clear account of the dynamic interplay between cell growth and metal biointerfacial partitioning is still very scarce. Recently, we proposed an integrative theory where metal transport, adsorption, excretion, internalisation and depletion processes are rigorously accounted for.[1–3] In addition, the effects of the intracellular metal binding by strong proteinaceous chelatant on metal bioutake is also tackled.[4] In this presentation, the theory is briefly presented together with supporting experimental data collected on bacteria suspensions exposed to Cd(II) solutions. It is shown how a critical examination of these data with help of theory can be valuable in deciphering the mechanisms governing the partitioning of metal at the cell−solution interphase and its bioavailability over time. This approach was then generalized for metal sensing-whole-cell bioreporter systems in order to relate the rate of emitted light with the cascade events leading to production of luminescence.[5] We will provide illustrative examples showing the ability of biosensors to offer new insights in analyzing uptake dynamics of metallic contaminants.

[1] Rotureau *et al.* (2015) Environ. Sci. Technol. **49**, 990–998, [2] Duval (2013) Phys. Chem. Chem. Phys.**15**, 7873–7888, [3] Duval & Rotureau (2014) Phys. Chem. Chem. Phys. **16**, 7401–7416, [4] Présent *et al.* (2017) Phys. Chem. Chem. Phys. **19**, 29114–29124. [5] Pagnout *et al.* (submitted)