Metal speciation in aquatic media elucidated with the emerging technique AGNES

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One relevant information in metal speciation is the distribution of the total concentration between what is bound to ligands and what is "free" (i.e. just solvated with water molecules). Indeed, free metal ion concentration plays a relevant role in several processes such as mineral precipitation, adsorption to colloids, complexation of dissolved organic matter, bioavailability of nutrients, toxicity of pollutants, etc. It can also prove crucial to validate (bio)geochemical models. The novel methodology AGNES (Absence of Gradients and Nernstian Equilibrium Stripping) has been specifically designed [1] to determine free metal concentrations (such as Zn^{2+}, Cd^{2+}, Pb^{2+}, In^{3+}, Sn^{2+}, etc.) or closely related species (e.g. the concentration of $Sb(OH)_3$ in the case of antimony [2]). We will review the principles, developments and outstanding applications of the electroanalytical technique AGNES including matrices such as river, estuarine and sea waters, soil extracts, growth media, etc. AGNES has been able to follow the kinetics of dissolution of ZnO nanoparticles by measuring the free zinc concentration (without any previous separation) in 5 minutes time intervals [3]. The presence of phosphates delays the dissolution of these nanoparticles [4]. The solubility of $In(OH)_3$ at various pH values has also been studied [5].

The free metal ion concentration provided by AGNES is complementary to the labile fraction provided by the popular technique Diffusive Gradients in Thin films (DGT) which, besides the free concentration, also quantifies the supply from mobile and labile complexes[6].

References

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