# Metal adsorption by diatoms: a surface complexation model

A. GELABERT[1,2] , O.POKROVSKY[2] , J. SCHOTT[2] AND A. BOUDOU[3]

[1] Department of Geological & Environmental Sciences 450 Serra Mall, Braun Hall, Building 320,Stanford University, Stanford, CA 94305-2115, USA
gelabert@stanford.edu

[2] Laboratoire des Mecanismes et Transferts en Geologie, OMP, Avenue Edouard Belin, 31400, Toulouse, France

[3] LEESA, UMR CNRS 5805, Université de Bordeaux 1 33120, Arcachon, France

Diatoms, unicellular algae enclosed in an external siliceous skeleton, account for a quarter of all the photosynthesis on earth. As their cell wall is known to display a high affinity for a wide range of aqueous metal cations, they are likely to play a key role in metal speciation and distribution in many aquatic systems.

We have studied the cell wall characteristics of four diatom species [1]. This complex 3D-cell wall structure is mainly composed of polysaccharides and proteins coating the silica frustule, and the main surface moieties are amino, carboxyl and silanol groups that control surface charge.

Complexation between divalent metal cations $Zn^{2+}$, $Cd^{2+}$, $Pb^{2+}$ and diatom cell walls were investigated by adsorption experiments as a function of pH, metal concentration and exposure time. While the shape of the pH-dependent adsorption edge for a given metal is almost the same for all four species, the constant pH adsorption isotherm and maximal metal binding capacities may differ significantly. From the metal adsorption results a surface complexation model was developed [2].

Zn K-edge X-ray absorption fine structure (XAFS) spectroscopy for zinc adsorbed onto the diatom surface [3] indicates i) that siliceous frustule plays a minor rule compared to organic coatings during the metal adsorption process and ii) metal complexation is governed by carboxylic groups from the surface in agreement with the surface speciation model developed from macroscopic adsorption experiments. XAFS spectroscopy also indicates that zinc is tetrahedrally coordinated on the cell surface and octahedrally coordinated in solution.

## References

[1] Gélabert A., Pokrovsky O.S., Schott J., Boudou A., Feurtet-Mazel A., Mielczarski J., Mielczarski E., Mesmer-Dudons N. and Spalla O. (2004) *GCA* **68**, 4039–4058.

[2] Gélabert A., Pokrovsky O.S., Viers J., Schott J., Boudou A., Feurtet-Mazel A. (2006) *GCA* **70**, 839–857.

[3] Pokrovsky O.S., Pokrovski G.S., Gélabert A., Schott J., Boudou A., (2005) *Environ. Sci. Technol.* **39**, 4490–4498.