Nano-imaging of *in-situ* growth and dissolution of hydroxyapatite using atomic force microscopy

K. SCHILLING AND L. N. LAMMERS[1]

[1]Dept. Environmental Science & Policy Management, University of California, Berkeley, USA, (*kschilling@berkeley.edu)

The mineral hydroxyapatite (HA) is of wide interest in the field of biogeochemistry as an effective medium for *in-situ* immobilization of heavy metal and radionuclide contaminants, and as the mineral component of vetebrate skeletal material. Hydroxyapatite primarily consists of Ca^{2+}, PO_4^{3-}, and OH^- ions, but other species including metals and radionuclides (e.g. U, Pb, Se, etc.) can substitute extensively into the HAP lattice, altering the bulk mineral properties. Prior work suggests that HAP growth proceeds via cluster attachment to steps at low supersaturation [1], presumably transitioning to direct cluster deposition on steps and terraces with increasing supersaturation. To date, no mechanistic link between HA composition and nano-scale reactivity has been established.

We have performed an investigation of *in-situ* HA growth and dissolution at the nano-scale using atomic force microscopy (AFM). Growth and dissolution kinetics and mechanisms were determined as a function of supersaturation and Ca:P ratio. Since HAP solubility increases greatly with carbonate content [2], carbonate-substituted HA (0-10%) was used as a model system to test the influence of bulk stability on HA dissolution kinetics. Our results provide a better insight into nano-scale mineral properties and surface kinetics of HA. This can improve the application of HA as remediation amendment by optimizing surface reactivity and composition.

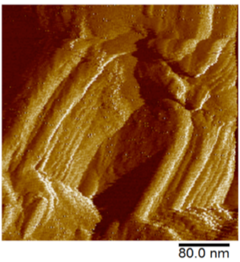

Figure: AFM image of calcined HA showing a rhombohedral etch pit during dissolution in deionized water (pH 8).

[1] Onuma et al., (1995), *J. Cryst. Growth*, **154**, 118-125. [2] Wang & Nancollas, (2008), *Chem. Rev.*, **108**, 4628-4669.