Oxide dependent adhesion of the Jurkat line of T-Lymphocytes

MARK J. STEVENS¹, LESLIE J. DONATO², STEVEN K. LOWER³ AND NITA SAHAI¹

¹Department of Geology and Geophysics, 1215 West Dayton Street, ²Department of Biochemistry, 433 Babcock Drive, University of Wisconsin, Madison, WI 53706, USA (mjstevens@live.com, sahai@geology.wis.edu, donato@wisc.edu)

³Department of Geology, 125 S. Oval Mall, Ohio State University, Columbus, OH 43210, USA (lower.9@osu.edu)

The adhesion force of immune-system cells (T-lymphocytes) with orthopaedic implants materials was measured using Atomic Force Microscopy (AFM) at pH 7.2 on quartz (100) and (10 1), silica glass, rutile (100), polycrystalline corundum, and mica (001). T-lymphocyte adhesion strength increases as negative surface charge on the substrates decreases, correlating with point of zero charge (PZC). This is interpreted as electrostatic bonding between negatively-charged cell surface glycoproteins and charged substrate surfaces. Further, saw-tooth shaped force-distance profiles also indicate unfolding of specific modular (glyco)proteins. Thus, crystal chemistry and interfacial solvation, which control PZC, along with specific (glyco)protein bonds, control immune system cell adhesion to oxide-based implants.

Elucidating dominant mechanisms of nanocrystalline uraninite reoxidation by Fe(III)(hydr)oxides

BRANDY D. STEWART AND BRENT M. PEYTON*

Department of Chemical and Biological Engineering, Montana State University, Bozeman, MT 59717 (brandy.stewart@erc.montana.edu *correspondence:bpeyton@coe.montana.edu)

Historic uranium mining and enrichment activities over the last century have created a legacy of radioactive wastes and co-contaminants that demand our long term stewardship. Due to both chemical and radioactive toxicity, uranium-laden water within these complex waste streams is a concern to both human and ecosystem health. The mobility and bioavailability of uranium in subsurface settings is dependent on an intricate combination of abiotic, biotic, and coupled reactions that often dictate oxidation state, aqueous complexation, and association with mineral surfaces. Despite the promise of reductive immobilization as a means of decreasing U(VI) concentrations in groundwater, emerging studies have revealed the propensity of biogenic UO2 to reoxidize in the presence of nitrate, Fe(III), and molecular oxygen. In several instances Fe(III) (hydr)oxides, common constituents of soils and sediments have been show to reoxidize (and remobilize) biogenic UO2. However the mechanism of this process remains unresolved. We have investigated the influence of electron shuttling and Fe(III)-chelating compounds on reoxidation of biogenic UO₂ by ferrihydrite, goethite, and hematite-coated quartz sand in batch systems. Starting Fe and U concentrations were 2.5 and 0.12 mM respectively. Results thus far indicate that desferroxamine B (DFB) and riboflavin added in concentrations of 0.1 mM promote soluble U(VI) in solution following 7 d of incubation, while U(VI) is not detectable in un-amended systems.