CE 543 Adv Topics: Environmental Biogeochemistry SLN 06419

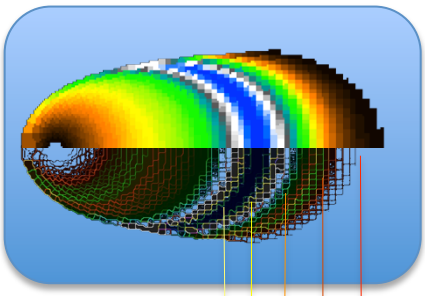
When: MWF 11:10-12:00 ***Where***: CLAR 147 ***Who***: Prof. Tim Ginn, perky for an old guy
Why: Essentially every environmental science/engineering problem involves some combination of environmental fluid mechanics, aqueous and surface (geo-)chemistry, and environmental microbiology. This class integrates elements from each one of these fields under the umbrella of mathematical modeling of multicomponent reactive transport processes in aqueous environmental systems (aquifers, lakes, rivers, oceans, estuaries, swamps, wastewater streams, chemical reactors, biochemical reactors, raindrops, etc.). This provides a basic understanding of the means by which we quantify complicated environmental fate and transport processes so that we can analyze, simulate, and maybe even predict them, as well as test hypotheses about how we might control them.
What: Survey of chemical and microbiological reactions in environmental aqueous/solid surface mixed media; quantification of equilibrium and kinetic mass transformations; Incorporation of multicomponent, mixed kinetic-equilibrium mass transformation models into deterministic reactive transport models; application through the USGS computer program PHREEQC.
How: Lecture format with 5 homeworks and a project applying reactive transport simulation to a problem of your choice (e.g., your research area) or one of the below, or something else! We will use the book Geochemistry, Groundwater, and Pollution C.A. J. Appelo and D. Postma, and the PHREEQCIIManual.pdf http://wwwbrr.cr.usgs.gov/projects/GWC_coupled/phreeqci/
Students should have some exposure to aqueous chemistry, differential equations, and basic fluid mechanics. Two out of three ain't bad, and can be fixed with energy.

Some example areas:

Bioremediation

Plan view of well injection

(groundwater flow direction)



methanogenesis

sulfate reduction

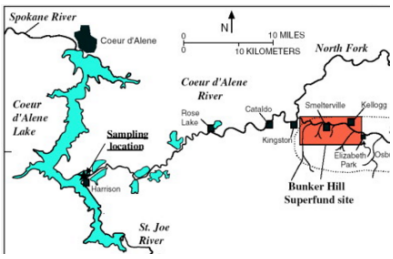
FeIII/MnIV reduction

nitrate reduction

aerobic respiration

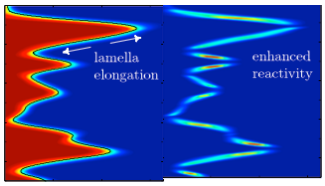
Acid-Mine Drainage

Lake Coeur d'Alene



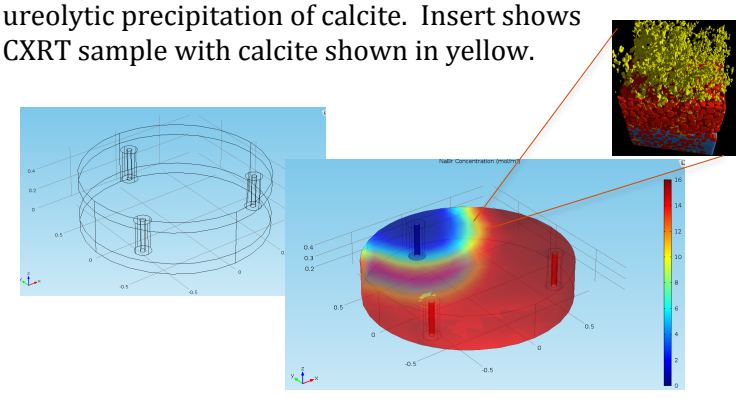
Upscaling Reactions

When mixing between solutions is restricted



Microbe-Induced Calcite Precipitation

2-meter tank with 3 wells used to test in-situ ureolytic precipitation of calcite. Insert shows CXRT sample with calcite shown in yellow.



Ocean Acidification

Carbon impacts on coral reefs