

**ADVANCED GEOCHEMISTRY OF NATURAL WATERS**  
**GEOL 578**  
**COURSE OUTLINE**

**Overall objective:** To understand in detail the fundamental (primarily thermodynamic) controls on the composition of natural waters and the response of natural waters to variations in various physico-chemical parameters. To explore applications to environmental problems, weathering, oceanography, ore deposit formation, etc. To learn to solve numerical problems related to the behavior of components in natural waters. To gain facility with simple analytical techniques for the characterization of natural waters.

**The course is organized around six main topics:**

- I. Brief review of chemical thermodynamics
  - A. Free energy, equilibrium
  - B. Equilibrium constants, activity
  - C. Temperature dependence
- II. Acids and bases
  - A. Definitions
  - B. pH as a variable
  - C. pH buffers
  - D. Calculation of equilibrium species distributions
  - E. Alkalinity and acidity
  - F. Titration theory
- III. Behavior of CO<sub>2</sub> in aqueous fluids and influence on pH.
- IV. Solubility phenomena
  - A. Oxides and hydroxides
  - B. Carbonates
  - C. Sulfides, phosphates and others.
- V. Metal ions and complexes in aqueous solution
  - A. Hydrolysis
  - B. Complexation
  - C. Chelation
  - D. Inorganic vs. organic complexes
  - E. Importance of metal speciation
- VI. Redox phenomena
  - A. Electrode potential
  - B. Eh-pH, pe-pH diagrams

**Course text:** Werner and Stumm (1996) Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters, 3rd. ed., John Wiley & Sons, 1021 p.

**Method of evaluation:**

GEOL 578: Problem sets - 40%; midterm exam - 30%; final exam - 30%.

**COURSE WEB SITE:** <http://www.sci.uidaho.edu/geol578/>

