Spring 2011

SYLLABUS: EART 134, THERMOCHEMISTRY OF GEOLOGICAL SYSTEMS
Tuesday/Thursday, 10-11.45, E & MS Rm. D236
Q. Williams, instructor, Office Hours (A212) Wed. 10-12 or by apptmt.; e-mail = qwilliams@pmc.ucsc.edu

lecture 1: Introduction, overview and organization: Thermochemistry in the Earth Sciences; Forms of work (3/29).
lecture 2: Introduction/review thermodynamics: Three laws, free energies, entropy and equilibrium (3/31).
lecture 3: Thermodynamics: Defining activities, fugacities, and equations of state (4/5).
lecture 4: Origins of Thermal Properties: Heat capacities, compressibilities, thermal expansion (4/7)
lecture 5: The phase rule, phase diagrams and calculation of phase diagrams (4/12).
lecture 6: Extraction of thermodynamic properties from phase equilibrium results (4/14).
lecture 7: Calculation of phase diagrams: geological/geophysical applications (4/19).
lecture 8: Ideal and non-ideal solution models (4/21).
lecture 9: Introductory geothermometry/geobarometry (4/26).
lecture 10: More geothermometry/geobarometry, and some element partitioning (4/28).
lecture 11: Mid-Term (5/3).
lecture 12: Element partitioning, solid/solid and solid/liquid (5/5).
lecture 13: Thermodynamic and structural properties of silicate melts (5/10).
lecture 14: Effect of volatiles and oxygen fugacity on silicate melts (5/12).
lecture 15: Aqueous solutions: Solubility mechanisms, ionization, dissociation and activity (5/17)
lecture 16: Aqueous solutions: oxidation potentials, hydrogen potentials, conductivity and Debye-Huckel theory (5/19).
lecture 17: Aqueous solutions: Implications for seawater chemistry and ore deposit formation and weathering (5/24).
lecture 18: Kinetics of reactions: Rate laws and transition state theory: why thermodynamics isn't the be-all and end-all of geologic processes (5/26).
lecture 19: Kinetics of reactions: Applications to geological systems (5/31)
lecture 20: Review (6/2)

The final exam is on Thurs. June 9, 12-3…

Requirements

1. Roughly Biweekly Homework Assignments (40% of grade)

2. Weekly Readings (typically 1-2 papers/week—delivered in class)

3. Mid-Term (20% of grade)

4. Final or Final Paper (Graduate Student Option: Research oriented) (40% of grade)

A Few Possible Supplementary (Reserve) Readings:

B.J. Wood and D.G. Fraser, Elementary Thermodynamics for Geologists, Oxford Press, 1977. A relatively nice cookbook-style text, most valuable for its worked examples.

D.K. Nordstrom and J.L. Munoz, Geochemical Thermodynamics, Blackwell, London, 1986. Good descriptions of some concepts, but somewhat weak in its "hard-rock" discussions.

G.N. Lewis and M. Randall, Thermodynamics, McGraw-Hill, New York, 1961. A good traditional thermodynamics text, oriented for the chemically inclined.

H.B. Callen, Thermodynamics, John Wiley, New York, 1960. A more physics-oriented text, approaching thermodynamics from a more statistical viewpoint than is commonly found.