Department of Earth and Planetary Sciences

EPSC-220
Principles of Geochemistry
Tentative Course Outline

Fall term 2017
Lectures: Mondays and Wednesdays 11:35AM – 12:25AM (FDA-315)
Laboratory: Tuesdays 2:35PM- 5:25PM (FDA-211)
Professors: Alfonso Mucci (alfonso.mucci@mcgill.ca), FDA-201
Anthony Williams-Jones (anthony.williams-jones@mcgill.ca), FDA-317
Teaching assistants: Benjamin Keenan (benjamin.keenan@mail.mcgill.ca), FDA-349
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All course slides, assignments, laboratories as well as the syllabus are posted at:
http://eps.mcgill.ca/~courses/c220/

Week	***Subject***
1	Introduction -organization (course description and schedule), books, evaluation
1	Origin of elements (AM) -The Big Bang -Cosmic abundances and nucleosynthesis -Terrestrial abundances
2/3	Chemical thermodynamics and phase equilibria (AM) -Thermodynamic systems -Intensive and extensive properties -Equilibrium versus steady state -Reversible and irreversible processes -Metastable equilibrium -Fundamental relationships (ΔE, ΔH, ΔA, ΔG, C_p) and laws of thermodynamics -Ideal gases
3/4	-Gibbs free energy, chemical potential and the law of mass action (AW-J) -Influence of P and T on free energy and the Clausius-Clapeyron equation -Activity and fugacity
5	The phase rule (AW-J) -Binary phase diagrams

6 Water chemistry (AM)
-Acid-base reactions
-Redox reactions
-Eh-pH diagrams
-Complexation reactions
-Solubility concept

7 Weathering (AM)
-Congruent dissolution reactions
-Incongruent dissolution reactions
-Redox reactions
-Soil development

8/9 Isotope Geochemistry (AW-J)
-Stable isotopes
-Radiogenic isotopes

10 Hydrothermal Processes (AW-J)
-Fluid-rock interaction.
-Black smokers
-Geothermal systems
-Physico-chemical controls of ore deposition

11 Elemental cycles (AW-J)

12/13 Chemical kinetics (AM)
-Rate determining step
-Elementary reactions
-Rate expressions for elementary reactions
-Reaction order
-Complex reactions
-Influence of T on reaction rate, Arrhenius equation
-Nucleation and crystal growth

14 Organic geochemistry (AM)
-Terminology
-Maturation of organic matter
-Hydrocarbons in crude oil

Evaluation:	Mid-term	30% (October 17, 2017_)
	Problem sets/assignments	30%
	Final exam	40%

Reference books:

White William M. (2005) Geochemistry, Wiley-Blackwell, Hoboken, NJ, USA
On line textbook: http://www.imwa.info/geochemistry/http://www.eps.mcgill.ca/~courses/c220

Anderson, G.M (1996) Thermodynamics of Natural Systems, Wiley & Sons, Toronto, 382pp.

Broecker, W. S. (1985) How to Build a Habitable Planet, Eldigio Press, Palisades, N.Y., 291pp.

Brownlow A.H. (1996) Geeochemistry, Second Edition, Prentice Hall, New Jersey, 580pp.

Drever, J. I. (1982) The Geochemistry of Natural Waters, Prentice- Hall, Englewood Cliffs, N.J., 388pp.

Faure, G. (1991) Principles and Applications of Inorganic Geochemistry, MacMillan Publishing Co., New York, 626pp.

Henderson, P. (1982) Inorganic Geochemistry, Pergamon Press, Oxford, 353pp.

Krauskoff K.B. and Bird D.K. (1995) Introduction to Geochemistry. Third Edition, McGraw-Hill, New York, 647pp.

Lasaga, A.C. and Kirkpatrick R.J. (1981) Kinetics of Geochemical Processes, Reviews in Mineralogy, Vol. 8, Mineralogical Society of America, Washington, 398pp.

Nordstrom D.K. and Munoz J.L. (1985) Geochemical Thermodynamics, The Benjamin/Cummings Publishing Co. Inc., Menlo park, 477pp.

Stumm, W. and Morgan, J.J. (1981) Aquatic Chemistry, John Wiley & Sons, New York, 780pp.

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