

Earth & Space Sciences 312: Geochemistry

Syllabus: Spring 2015

Instructor:

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Teaching Assistants:

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Lectures:	Crystal Chemistry	(3-4 lectures)	30 Mar – 6 April
	Thermodynamics	(4-5 lectures)	6 – 17 April
	Trace Element Geochemistry	(4-5 lectures)	20 – 27 April
	Radiogenic Isotopes	(3 lectures)	29 April – 8 May
	Midterm exam	Friday, 1 May	(in lecture period)
	Aqueous geochemistry	(4 lectures)	11 – 18 May
	Stable Isotopes	(3 lectures)	20 – 27 May
	Global geochemical cycles	(3 lectures)	29 May – 3 June
	Final examination	Tuesday, 9 June	(8:30 - 10:20)

Laboratories:

- Week 1 Review and warm-up problem set (optional attendance)
- Week 2 Silicate crystal chemistry
- Week 3 Determining P and T of mineral formation
- Week 4 Trace element geochemistry (introduction to spreadsheets)
- Week 5 M (27 April) Intro Radioactivity W (29 April): Review
Friday (1 May): **Midterm** in lecture period;
- Week 6 Radioisotopes and mantle differentiation
- Week 7 Weathering reactions and mineral stability
- Week 8 Trace elements and stable isotopes in corals
- Week 9 M: Memorial Day W: Modeling the carbon cycle
- Week 10 Finish carbon cycle lab

Textbooks: Either: *Geochemistry: Pathways and Processes* McSween, Richardson and Uhle. 2nd edition (2003). Columbia University Press.

Or: *Principles and Applications of Geochemistry* Faure. 2nd edition (1998). Prentice Hall.

Assessment:	Midterm	25%
	Final	35%
	Labs	40%

Lecture and reading guide (McSween & Richardson, Geochemistry)

		Lectures	Reading McSween & Richardson
<u>1</u>	Mar. 30 Apr. 1 Apr. 3	Crystal chemistry to planetary differentiation Composition of chemical reservoirs in earth Principles that control the distribution of the elements	Ch. 1 (1-5, 9-10) Chapter 2 Ch. 12 (227 – 233)
<u>2</u>	Apr. 6 Apr. 8 Apr. 10	Trace element distribution example - rare earth elements Thermodynamics of geological systems Equilibrium and free energy concepts How changing P and T changes equilibrium	Chapter 3 Review partial differentiation and integration
<u>3</u>	Apr. 13 Apr. 15 Apr. 17	How changing composition changes equilibrium Henry's and Raoult's laws, activity	Chapter 9 Chapter 4
<u>4</u>	Apr. 20 Apr. 22 Apr. 24	Trace element clues to geological processes Element partitioning between minerals and magma, Differentiation and geochemical reservoirs	Chapter 4 Ch. 12 (233 – 262)
<u>5</u>	Apr. 27 Apr. 29 May 1	Radioactivity and geochronology Radiogenic isotope signatures and differentiation Mid-term exam (during lecture period 8:30 - 9:20)	286-294, handouts Chapter 14 (302-310)
<u>6</u>	May 4 May 6 May 8	Planetary differentiation Global elemental and isotopic reservoirs Nucleosynthesis: age and origin of the elements	Ch 15 (313-323) Ch 4 (71-75), handouts
<u>7</u>	May 11 May 13 May 15	Aqueous geochemistry and natural waters Solubility calculations Non-ideal solutions	Ch 4 (68-76), handouts
<u>8</u>	May 18 May 20 May 22	pH and carbonate equilibria Aluminosilicate reactions, rock weathering Stable isotopes - introduction	143-150 Chapter 7 (111-121)
<u>9</u>	May 25 May 28 May 30	Memorial Day holiday Stable isotope fractionation, paleothermometry Stable isotope tracers and fingerprinting	Chapter 13 266-271 271-279
<u>10</u>	June 1 June 3 June 5	Global geochemical cycles and time perspectives Carbon and strontium cycles on short and long timescales Review	Chapter 8 Handouts
	June 9	Final exam - Tuesday June 9	8:30 – 10:20 am

Lecture and reading guide (Faure, Principles & Applications of Geochemistry)

		Lectures	Reading Faure
<u>1</u>	Mar. 30 Apr. 1 Apr. 3	Crystal chemistry to planetary differentiation Composition of chemical reservoirs in earth Principles that control the distribution of the elements	Chapters 6-8 Some bckgd in Ch 4
<u>2</u>	Apr. 6 Apr. 8 Apr. 10	Trace element distribution example - rare earth elements Thermodynamics of geological systems Equilibrium and free energy concepts How changing P and T changes equilibrium	Chapter 11 Review partial differentiation and integration
<u>3</u>	Apr. 13 Apr. 15 Apr. 17	How changing composition changes equilibrium Henry's and Raoult's laws, activity	Chapter 11
<u>4</u>	Apr. 20 Apr. 22 Apr. 24	Trace element clues to geological processes Element partitioning between minerals and magma, Differentiation and geochemical reservoirs	Chapter 4 handouts
<u>5</u>	Apr. 27 Apr. 29 May 1	Radioactivity and geochronology Radiogenic isotope signatures and differentiation Mid-term exam (during lecture period 8:30 - 9:20)	Chapter 16, handouts
<u>6</u>	May 4 May 6 May 8	Planetary differentiation Global elemental and isotopic reservoirs Nucleosynthesis: age and origin of the elements	Ch 4, handouts, Ch 2 for interest (sections 2.2, 2.3)
<u>7</u>	May 11 May 13 May 15	Aqueous geochemistry and natural waters Solubility calculations Non-ideal solutions	Ch 9, 10, 11.8, 11.9 (Ch 14 interest only), handouts
<u>8</u>	May 18 May 20 May 22	pH and carbonate equilibria Aluminosilicate reactions, rock weathering Stable isotopes - introduction	Ch 12, 13.4, 19, sections 9.6, 11.11, 13.1-13.2 as bckgd
<u>9</u>	May 25 May 28 May 30	Memorial Day holiday Stable isotope fractionation, paleothermometry Stable isotope tracers and fingerprinting	Chapter 17 handouts
<u>10</u>	June 1 June 3 June 5	Global geochemical cycles and time perspectives Carbon and strontium cycles on short and long timescales Review	Chapter 22 (17.8, 23.6) Handouts
	June 9	Final exam - Tuesday June 9	8:30 – 10:20 am