D:\352\2007\generalinfo.wpd **EPSc 352: Earth Materials Fall, 2007**

General Information about the Course

Goals: To provide a sound ***introduction*** to mineralogic concepts that are important for modern geoscientists with a wide range of intended fields of specialization, including environmental geology and space sciences. Topics of particular concern are crystal chemistry, basic symmetry and structure of crystals (minerals), basic X-ray analysis of crystalline materials, fundamental information on the important mineral groups (definition of the groups; composition, structure, physical properties, occurrence, and usage of major mineral species), and optical microscopy. By the end of the course, the student should have a fundamental knowledge of the major mineral groups, the geologic and chemical relations among minerals, and the importance of earth materials to the broader fields of geoscience and environmental science.

Pre-requisites for course: prior completion of EPSc 200A and first-semester college chemistry.

Class time: 3 one-hour lectures and 1 two-hour lab scheduled per week. Note: students will spend several additional hours per week in the lab. There is also a scheduled 1-day field trip.

Texts: One text is required, which includes an accompanying CD-ROM:
Klein, C. and Dutrow, B. 2008. Manual of Mineral Science. 23rd ed. John Wiley and Sons; accompanying CD-ROM also required. (Detailed text; reads well, although it is intense; excellent reference book.)

Teaching Assistants: Ph.D. graduate students **Kelsi Singer (ksinger@levee.wustl.edu) in office room 290 (tel. 935-4810) and Selby Cull (scull@levee.wustl.edu) in office room 275 (tel. 935-8594). Office hours to be announced.**

Course Web site: http://epsc.wustl.edu/classwork/classwork_352/

Dates to remember:

Monday, Sept. 3: No lecture or lab; Labor Day holiday.

Friday, September 14: **Homework #1** due.

Friday, September 21: **Homework #2** due.

Wednesday, October 3: **Homework #3** due.

Wednesday, October 10: **first in-class exam**.

Friday, October 19: Fall Break; no class

Monday-Wenesday, October 29-31: Special lectures and labs

Friday, November 2: **Homework #4** due.

Wednesday, November 7: **second in-class exam**.

Continued...

Monday, November 12: **first draft of your term paper** due.

Tuesday, November 13: Date for the all-day field trip (4am till 5pm). Details TBA.

Wed. and Fri., November 21 and 23: Thanksgiving Break; no classes.

Wednesday, Nov. 28: **Homework #5** due.

Friday, December 7: Last day of classes

Monday, December 10: **Final version of term paper due**.

Tuesday, December 18: **Final Exam at 10:30am - 12:30pm.**

Requirements of the course:

Class attendance is required (attendance will be taken).

Other requirements: reading of assigned materials; 2 in-class exams, final exam; several written homework assignments; participation in weekly labs, written materials checked & graded by T.A./professor; a field trip; one term paper with about 15 double-spaced pages of text (+ bibliography, figures, tables).

Students are expected to respond to questions asked by the professor in class. Occasional pop quizzes will be given to alert students to the kinds of specific materials that they need to know and understand.**** [**see next page]**

Class and lab assignments must be handed in on the date due in order to receive full credit; **penalty for lateness is 5% per day; materials that are more than 3 days late will not be accepted for a grade**.

Professor's Office hours:

I usually keep my office door (EPSc bldg., rm. 233) open for questions as students see fit. I post notes on the door to tell people where they can find me. I definitely encourage students to come and talk to me about: questions relating to the class material, perceived difficulties in the course, suggestions for changes in the course, mineralogic topics of interest to them, etc. Tel. 935-5434; e-mail: pasteris@levee.wustl.edu

Grading in the Course

My intention is to weight the "activities" of the course as follows**:

20% for homework (the mineral quiz/quizzes in lab count as one homework each)
20% for in-class exams (2 of these)
25% for labs (after dropping each student's lowest lab grade)
15% for the term paper
20% for the final exam

**I think that class participation is important. Therefore, I use it as a "positive increment" factor. A student's grade can be elevated by as much as one grade increment (e.g., from B^+ to A^-) by consistent participation in class discussions and questions, handing in voluntary assignments (announced in class), and by doing well on pop quizzes. For your information, in past years, I have had as many as 3 out of 20 students raise their grades one notch by availing themselves of these opportunities.

Some Suggestions for Topics for the Term Paper on Earth Materials

First written draft due Nov. 12th; final version due Dec. 10th. The following are just suggestions; you are welcome to choose other topics. Please discuss your topic–even from this list-- with me **before** beginning any major research.

"Classical" Mineralogy Topics

[*For a good overview of some interesting mineralogical topics, accompanied by short articles on those topics, see: Frye, K., editor. 1981. The Encyclopedia of Mineralogy. Volume IVB of the Encyclopedia of Earth Sciences. Stroudsburg, PA: Hutchinson Ross Publ. Co.; in EPSc library, QE355.R6.]*

--Mineral fluorescence

--Some selected aspect(s) of the cause of color in minerals, especially if you have a good physics background (conduction-band theory)

--Detailed discussion of the processing or manufacture of some mineral-based material (e.g., making of cement; processing of uranium ore into reactor pellets)

--Detailed discussion of the smelting process of some type of ore, e.g., iron oxides or copper sulfides

--Mineralogy and formation of opal, graphite, or other mineral

--Formation of "salt" (evaporite) deposits, bauxite (Al) deposits, or analogous deposits

--Natural and synthetic forms of silica

--Some aspect of crystallization of solids from melt or aqueous fluid

--Formation of soil

--A chemical/structural analysis technique for minerals or rocks, e.g., X-ray fluorescence, transmission electron microscopy, electron microprobe analysis, infrared spectroscopy, Raman spectroscopy

--Formation of dolomite

--Some aspect of deformation or recrystallization in metamorphic rocks

--Metamictization (radiation damage) in a mineral(s)

--High-pressure phase(s) assumed to exist in the earth's mantle

--Chemical diffusion in minerals

--Aerogels

--Nanotubes

--Vapor-deposited diamond films

--Formation of nanocrystals

--Causes of zoning in minerals

--Formation of sulfide “chimneys” at ocean-ridge spreading centers (challenging topic)

–Industrial process of converting rock (“ore”) into usable metal (Cu or Fe or Al, etc.)

Biological and Environmental Mineralogy Topics

--Biomineralization, i.e., production of “minerals” by living organisms

--Natural mineral composites, e.g., bone, carbonate shells

--Formation of minerals in the body--what, where, why, how analyzed; e.g., kidney stones

--Processing of natural phosphates into fertilizer and the environmental impacts of this process

–Remediation use of apatite (Ca phosphate) to collect and sequester heavy metals

--Development of rock-like materials to contain nuclear waste (e.g., SYNROC)

--Some aspect(s) of the health effects of asbestos or some other mineral (e.g., quartz and silicosis)--from a mineralogical viewpoint

--Clay minerals and cation exchange in environmental processes

--Zeolites (natural and synthetic) and their use in environmental clean-up

--Sulfide minerals and acid mine drainage

--Microbe-mineral interactions

--Environmental regulations for small (<10 and <2.5 μm) particles: mineral phases, particle analysis, health problems

--Clathrate hydrates, e.g., as a means of storing (sequestering) greenhouse gases, formation and effects on climate, destabilization as a cause of underwater landslides and sudden release of CO_2 and CH_4

Overview of EPSc 352 Earth Materials

Minerals

hand-sample I.D.
material properties
environmental issues
compo. groups
structural groups
geologic occurrence
industrial uses

Crystal-Chemistry

chemistry
bonding
structure(-composition)
infer genesis from composition
phase diagrams
compositional analysis, e.g., electron microprobe

Crystallography

axial systems of crystals
details of atomic structure of minerals
symmetry: atomic to hand scales
structural analysis, e.g., X-ray diffraction

Optical Mineralogy

physics of light-solid interactions
how light propagates through anisotropic minerals
use of petrographic microscope
identification of minerals using polarized light
relations of optical properties and symmetry

2007 Tentative Schedule: Updates Provided in Class

Week of:	Mineralogic Topics	Reading Assignment	CD Module	Lab Exercise
Aug. 29	Define mineral, earth's chemistry, element partitioning	KD 1, 3		
Sept. 3	**[Sept. 3 holiday]** Electron configuration, bonding, ionic-packing model	KD 3, 4 (thru p. 68)	I	1. World Wide Web: at home
Sept. 10	Closest packing, coordination polyhedra, Pauling's rules. Mineral composition, solid solution. **Homework #1 due Friday, 9/14.**	KD 4 (pp. 68-89), KD 5	I	2. Bonding & Structure
Sept. 17	Binary phase diagrams. **Homework #2 due Friday, 9/21.**	KD 2; Ehlers ch. 1,2		3. Minerals 1: non-silicates
Sept. 24	Binary phase diagrams (cont.); fractionation; zoning.	KD 2; Ehlers ch. 1,2		4. Minerals 2: silicates
Oct. 1	Crystal growth; morphological crystallography. **Homework #3 due Wednesday, 10/3.**	KD 10 (pp. 217-234), KD 12 (pp. 266-281)	II "Crystal growth"	5. Crystal Growth
Oct. 8	**EXAM #1 on Wednesday, 10/10.** Symmetry, crystal systems. Internal symmetry.	KD 6 (to p. 131)	II, III	6. Symmetry
Oct. 15	Lattices, unit cells, Miller indices. Lines, forms, zones. **Fall break on Friday, 10/19.**	KD 6 (pp. 131-137), KD 7	II, III	7. Symmetry
Oct. 22	Physical properties of minerals. X-ray diffraction (XRD)**.**	KD 14 (pp. 307-321), special readings		8. Miller Indexing; databases and library resources
Oct. 29	GSA meeting. Special guest lectures. XRD (cont.) **Homework #4 due Friday, 11/2.**	KD 14 (pp. 321-330)	IV	9. Visits to analytical labs
Nov. 5	Electron microprobes (SEM, TEM, EMPA). **EXAM#2 on Wednesday, 11/7.**	Optics TBA	IV	10. Begin optical microscopy
Nov. 12	Non-Silicate minerals. **First draft of term paper due on Monday, 11/12. All-day field trip for everyone on Tuesday, Nov. 13th.**	KD 15, 16 (some), Optics TBA	IV	11. Field trip for ALL on Tuesday
Nov. 19	**Thanksgiving holidays on Wednesday and Friday.**	KD 17 (some)		12. Campus Tour
Nov. 26	Environmental mineralogy. Silicate minerals. **Homework #5 due Monday, 11/26.**	KD 18 (some)	IV	13. Optical microscopy II

Week of:	Mineralogic Topics	Reading Assignment	CD Module	Lab Exercise
Dec. 3	Silicate minerals (final). **Friday is last day of class. Term Paper due on Mon. , 12/10.**	KD 18, 19 (some)	IV	14. Optical microscopy III
Dec. 18	**Final Exam on Tuesday, Dec. 18th at 10:30am - 12:30pm**.			

KD = your text by Klein and Dutrow; numbers refer to chapter numbers unless otherwise stated.

Ehlers= book on phase diagrams; book and copies of pertinent chapters are on reserve in EPSc library. Ask the librarian for them. Also sent as PDFs.