

EARTH MATERIALS, GEO416K, FALL 2012

Lecture: MWF 10-11A, UTC 4.112; Lab: EPS 2.102

Class Unique Numbers: 27400, 27405, 27410, 27415, 27420, 27425, 27430, 27435, 27438



"I knock at the stone's front door./"It's only me, let me come in."/ "I don't have a door," says the stone." Conversation with a Stone, Wislawa Szymborska

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1. Rationale

This course is geared towards introducing you to minerals, mineral study techniques, igneous and metamorphic rocks, ore deposits, and ore formation processes. Minerals are the fundamental building blocks of all rocks, and consequently the Earth and other planets. Mineralogy combines elements of physics, chemistry, math, and geology and is a descriptive, analytical, and experimental science. Mineralogists try to understand the physical properties, chemical composition, crystal structure, occurrence, and distribution of minerals, and the physical and chemical processes that lead to the formation and destruction of minerals in nature. Knowledge of mineralogy is the basis for the understanding of geological processes, including the formation and alteration of the Earth and other planets as a function of time. Many minerals influence the economy and play a meaningful role in political decision-making. This course will **focus primarily on igneous and metamorphic rocks** (as opposed to sedimentary rocks), and **ore deposits**. Minerals stimulate the development of important technological materials (metals, semiconductors, building materials, glasses, ceramics). Many modern analytical methods and instruments were developed so that mineralogical and geochemical problems could be solved.

2. Course Aims and Objectives*2.1. Aims*

The goal of this course is to improve your understanding the physical, chemical, crystallographic and structural properties of rocks and minerals. You will identify a range of minerals, and also igneous and metamorphic rocks. You will learn why these substances are important in our day-to-day lives.

2.2. Specific Learning Objectives

By the end of this course, students will:

- Develop an understanding of the history of the field of mineralogy and petrography, identify common rocks and minerals, learn about instruments used to study rocks and minerals, independently operate an optical microscope to identify minerals and textures in rock thin sections, associate mineral properties with their chemistry, develop an understanding of symmetry and its role in mineral classification, and learn about the origin of mineral properties (magnetism, color, radioactivity). Students will also learn to identify and begin to understand the origin of common igneous and metamorphic rocks. Students will be able to classify rock types, understand their formation, and learn why they could be important in our day-to-day lives.

- Complete lab assignments geared towards increasing skills they would use in the field and laboratory as geoscientists. Many rocks and minerals are identified based on their physical and optical properties, so students will learn to use an optical microscope and begin to identify specific textures within igneous and metamorphic rocks.

3. Format and Procedures

The course consists of **3 lecture hours and 4 laboratory hours** a week for one semester. During the lecture, we will discuss specific topics related to the course. You are expected to attend each lecture, take notes, and actively participate. **Labs in this class are required** and run 2 hours twice a week. During lab time, you will be expected to work on and complete a set of practical exercises that will help you understand the concepts presented in lecture. Come to lab on time and prepared.

Collaborate with your classmates to complete the lab exercises for this class. Asking each other questions, discussing samples, etc., are absolutely necessary to successfully complete the work. However, it is unacceptable to turn in any work that is not your own.

4. My Assumptions

Prerequisites for the course include GEO401, 303, or 312K with a grade of at least *C*, CHEM301 with a grade of at least *C*, and credit with a grade of at least *C* or registration for CHEM302. Based on these prerequisites, I assume that you may be able to identify a few common rocks and minerals and understand the basics of plate tectonics and chemistry. I assume you understand this class may involve chemistry, physics, and math, despite the fact that it is a geology course.

5. Course Requirements

5.1. Class attendance and participation policy

Attend all scheduled classes and arrive on time. Late arrivals and early departures are disruptive. While there is no point penalty specified for class absences, experience has shown a correlation between poor class attendance and low grades.

Keep all class and lab-work in a jumbo 3-ring binder. Periodically, the TAs and I may check to make sure that you are staying organized. Think of this class as a job: I expect you to show up on time, work hard, and make every effort to learn.

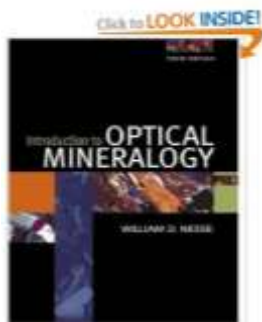
The expectation for all students in this course is that complete integrity will be demonstrated at all times. Academic dishonesty will be reported for administrative action. Although I encourage you to discuss the lab problems with each other and me, your answers should be written only by you.

5.2. Course Readings/Materials

Required Textbook: Klein, C., Dutrow, B. (2007) *Manual of Mineral Science (Manual of Mineralogy)*, 23rd edition, Wiley Publisher, 716 pages, ISBN-10: 0471721573, ISBN-13: 978-0471721574. (earlier editions are fine)

Recommended Textbook: Nesse, W.D. (2004) *Introduction to Optical Mineralogy*, 3rd edition, Oxford University Press, 370 pages, ISBN-10: 0195149106, ISBN-13: 978-0195149104. (earlier editions are fine)

Course packet: Purchase and download additional readings and laboratory exercises for the course from University Readers (<http://www.universityreaders.com/>). The course packet will be sent to you as a 3-hole punched in shrink wrap, and 20% of the reader should be available for immediate download. Purchase a binder to place the course packet in, and add some additional paper for questions you may need to answer during the laboratory.



Supplies needed: Bring a pencil to complete the laboratory exercises. Some labs require colored pencils and/or a calculator. We have hand lenses available, but you may like your own (10x magnification). Bring your required textbook to lab.

Library Reserves: Copies of the required and recommended textbooks are available in the Geology Library JGB4.202 for a loan period of 24 hours.

5.3. Use of Blackboard in Class

In this class I use Blackboard—a Web-based course management system with password-protected access at <http://courses.utexas.edu>—to distribute course materials, to communicate and collaborate online, to post grades, and to provide you practice lecture exams. You can find support in using Blackboard at the ITS Help Desk at 475-9400, Monday through Friday, 8 a.m. to 6 p.m.



I will post PowerPoint slides on Blackboard prior to each lecture and they will be available throughout the semester to help you study. You are welcome to bring your laptop to class and access these during lecture. However, recent studies indicate that students who bring laptops to class spend considerable time multitasking and distract other students. The level of laptop use *was negatively related* to measures of student learning, including self-reported understanding of course material and overall course performance (Fried, 2008, Computers & Education 50: 906–914).

6. Assignments, Assessment, and Evaluation

Grades in this course will be based on:

- Lecture Exam 1 (15%) multiple choice, graded by Dr. Catlos
- Lecture Exam 2 (15%) multiple choice, based on material since lecture exam 1, graded by Dr. Catlos
- Lecture Final Exam (20%) multiple choice, cumulative, graded by Dr. Catlos
- Lab Exercises (20%) short answer, graded by your TA
- Lab Exam 1 (15%) Labs 1-7 only, short answer, graded by your TA
- Lab Exam 2 (15%) Labs 8-15 only, short answer, graded by your TA, based on material since Lab Exam 1

Policy concerning laboratory exercises. Laboratory exercises should be completed and turned in during lab time. Some labs may take more than one period. Each question for the lab exercises has a clear point value; some labs are worth more points than others. We recommend that you read the labs and their assigned readings prior to your lab time.

Missing a Lab Exercise. If you know you will miss a lab exercise, you should inform your TA at least 1 week prior to missing that day.

Due to the nature and intense preparation involved in setting up these lab assignments, if you miss one, you may NOT be able to make it up completely.

We can make an effort to accommodate you in another lab time, but it cannot occur on a regular basis, as samples are limited and large class sizes are not ideal. All unexcused lab exercises will be docked 50% of the total points.

Policy concerning make-up exams. If you know you will miss an exam, you should inform Dr. Catlos and your TA at least 1 week prior to missing that day if possible. Documentation for why you will be missing that exam is required, and we will reschedule the makeup exam as soon as possible.

Subject-to-change notice. This syllabus represents the current plans and objectives of the course. As we go through the semester, those plans may need to change to enhance the class learning opportunity. Such changes, communicated clearly, are not unusual and should be expected.

7. Undergraduate Award



The student with the highest grade in this class will be nominated for the Mineralogical Society of America's American Mineralogist Undergraduate (AMU). This Award recognizes outstanding students who have shown an interest and ability in the discipline of mineralogy. The student will be presented with a certificate at the department's Spring awards ceremony and receive a *Reviews in Mineralogy and Geochemistry* or *Monograph* volume chosen by the student. See: www.minsocam.org/MSA/Awards/UnderGradAward.html. In 2010, the winner was Yanadet Sripanich.

8. List of Critical Dates

8.1. Class Administration

- **August 29** Wednesday: Classes begin.
- **September 4** Tuesday: Last day of the official add/drop period; after this date, changes in registration require the approval of the department chair and usually the student's dean.
- **September 14** Friday: Twelfth class day; this is the date the official enrollment count is taken. Last day an undergraduate student may add a class except for rare and extenuating circumstances. Last day to drop a class for a possible refund.
- **November 6** Tuesday: Last day an undergraduate student may, with the dean's approval, withdraw from the University or drop a class except for urgent and substantiated, nonacademic reasons. Last day a student may change registration in a class to or from the pass/fail or credit/no credit basis.
- **December 7** Friday: Last class day.

8.2. No classes

- **August 29, 30** Wednesday, Thursday: First week of classes, No Laboratory Hours.
- **September 3** Monday: Labor Day holiday. No Laboratory Hours.
- **September 4** Tuesday: Because of Labor Day, No Laboratory Hours.
- **November 21** Wednesday: Because of Thanksgiving, No Laboratory Hours.
- **November 22-24** Thursday-Saturday: Thanksgiving holidays. No Lecture or Laboratory Hours.

8.3. Professor away

- **October 1-5** Monday-Friday: International Aegean Scientific Conference.
- **November 4-7** Monday-Wednesday: Geological Society of America Conference.

8.4. Exam dates

- **October 8** Monday: Lecture Exam 1 (15%), multiple choice
- **October 22, 23** Monday, Tuesday: Lab Exam 1 (15%), short answer
- **November 14** Wednesday: Lecture Exam 2 (15%), multiple choice
- **December 5, 6** Wednesday, Thursday: Lab Exam 2 (15%), short answer
- **December 15** Saturday: 9:00am-12pm, Lecture Final Exam (20%), multiple choice

9. Academic Integrity

University of Texas Honor Code. The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the university is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community.

Each student in this course is expected to abide by the University of Texas Honor Code.

Any work submitted by a student in this course for academic credit will be the student's own work. Collaboration is allowed to complete the laboratory exercises, but it is unacceptable to turn in any work that is not your own. **Answers for the questions must be written in your own words.** You are encouraged to study together and to discuss information and concepts covered in lecture and lab with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an email, an email attachment, a disk, or a hard copy.

Should copying occur, both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment. Penalty for violation of this Code can also be extended to include failure of the course and University disciplinary action.

During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.

10. Other University Notices and Policies

- 10.1. *Q drop Policy*. The State of Texas has enacted a law that limits the number of course drops for academic reasons to six (6). As stated in Senate Bill 1231: “Beginning with the fall 2007 academic term, an institution of higher education may not permit an undergraduate student a total of more than six dropped courses, including any course a transfer student has dropped at another institution of higher education, unless the student shows good cause for dropping more than that number.”
- 10.2. *Documented Disability Statement*. Any student with a documented disability who requires academic accommodations should contact Services for Students with Disabilities (SSD) at (512) 471-6259 (voice) or 1-866-329-3986 (video phone). Faculty are not required to provide accommodations without an official accommodation letter from SSD. Please notify me as quickly as possible if the material being presented in class is not accessible (e.g., instructional videos need captioning, course packets are not readable for proper alternative text conversion, etc.).
- 10.3. *Behavior Concerns Advice Line (BCAL)*. If you are worried about someone who is acting differently, you may use the Behavior Concerns Advice Line to discuss by phone your concerns about another individual’s behavior. This service is provided through a partnership among the Office of the Dean of Students, the Counseling and Mental Health Center (CMHC), the Employee Assistance Program (EAP), and The University of Texas Police Department (UTPD). Call 512-232-5050 or visit <http://www.utexas.edu/safety/bcal>.
- 10.4. *Use of E-mail for Official Correspondence to Students*. It is the student's responsibility to keep the University informed as to changes in his or her e-mail address. Students are expected to check e-mail on a frequent and regular basis in order to stay current with University-related communications, recognizing that certain communications may be time-critical. It is recommended that e-mail be checked daily, but at a minimum, twice per week. The complete text of this policy and instructions for updating your e-mail address are available at <http://www.utexas.edu/its/policies/emailnotify.html>.
- 10.5. *Religious Holy Days*. By UT Austin policy, you must notify me of your pending absence at least fourteen days prior to the date of observance of a religious holy day. If you must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, I will give you an opportunity to complete the missed work within a reasonable time after the absence.
- 10.6. *Emergency Evacuation Policy*. Occupants of buildings on the UT Austin campus are required to evacuate and assemble outside when a fire alarm is activated or an announcement is made. Familiarize yourself with all exit doors of the classroom and the building. Remember that the nearest exit door may not be the one you used when you entered the building. If you require assistance to evacuate, inform me in writing during the first week of class. In the event of an evacuation, follow my instructions or those of class instructors. Do not re-enter a building unless you’re given instructions by the Austin Fire Department, the UT Austin Police Department, or the Fire Prevention Services office.

11. Tentative Course Schedule

This syllabus represents my current plans and objectives. As we go through the semester, those plans may need to change to enhance the class learning opportunity. Such changes, communicated clearly, are not unusual and should be expected.

Week/Dates	Main Topics	Readings	Laboratory Topic
Week 1			No Lab
8/29	Intro Course Outline & Details	Chp.1	
8/31	History of Mineralogy; Mineral Properties		
Week 2			Lab 1. Mineral Properties
9/3	HOLIDAY		
9/5	Mineral Identification in Hand Specimen	Chp. 2	
9/7	Review of Plate Tectonics, Elements, Bonding, Simple Structures	Chp. 3	
Week 3			Lab 2. Unusual Mineral Properties
9/10	Ionic Radii , Ion & bonding; Coordination and Crystal Structure	Chp. 4	
9/12	Concept of a Lattice and Description of Crystal Structures		
9/14	Coordination & Crystal Structure, Structures and Pauling’s Rules		
Week 4			Lab 3. Mineral Classification

			Lab 4. Silicate Minerals
9/17	Pauling's Rules, cont. Isomorphism, Polymorphism, Crystalline Effects		
9/19	Isomorphism, Polymorphism, Crystalline Effects, cont.		
9/21	Composition of the Earth; Mineral Compositions	Chp. 5	
Week 5	Lab 4, cont. Lab 5. Economic Minerals		
9/24	Igneous Rocks & Minerals	Chp. 21	
9/26	Igneous Rocks & Minerals		
9/28	Igneous Rocks & Minerals		
Week 6	Lab 6. Igneous Rocks in Hand Sample		
10/1	Metamorphic Minerals		
10/3	Metamorphic Rocks		
10/5	Lecture Exam Review		
Week 7	Lab 7. Classification of Igneous Rocks		
10/8	LECTURE EXAM 1		
10/10	Substitution Mechanisms, Origin of Color and Mineral Defects	Chp. 10	
10/12	Twinning; Magnetism		
Week 8	Lab 8. Metamorphic Rocks and Minerals		
10/15	Introduction to Crystallography; Symmetry	Chp. 6	
10/17	Symmetry Elements and Crystal Systems		
10/19	Symmetry Elements and Crystal Systems		
Week 9	Lab Exam and Lab 9. Symmetry		
10/22, 23	LAB EXAM 1		
10/22	Notation		
10/24	Translation and Dimensional Order	Chp. 7	
10/26	Lattices and Motifs		
Week 10	Lab 10. Symmetry with Blocks, Lab 11. Microscope Introduction		
10/29	Space Groups and Point Groups	Chp. 9	
10/31	Microscopic Identification of Minerals	Chp. 13	
11/2	Nature of Light		
Week 11	Lab 12. Basic Microscope Observations		
11/5	Isotropic vs. Anisotropic Minerals		
11/7	Uniaxial Crystals		
11/9	Biaxial Crystals		
Week 12	Lab 13. Interference Colors		
11/12	Lecture Exam Review		
11/14	LECTURE EXAM 2		
11/16	Introductory Thermodynamics	Chp. 11	
Week 13	Lab 14. Minerals in Thin Section		
11/19	Mineral Stability and Phase Diagrams		
11/21	Mineral Stability and Phase Diagrams		
11/23	HOLIDAY		
Week 14	Lab 15. Rocks in Thin Section		
11/26	Post Crystallization Processes	Chp. 12	
11/28	Polymorphism, pseudomorphism		
11/30	Gems	Chp. 20	
Week 15	Lab review (Dec. 3 and 4)		
12/5, 12/6	LAB EXAM 2		
12/3	Analytical Methods	Chp. 14	
12/5	Analytical Methods		
12/7	Final Exam Review		
12/15	FINAL EXAM		