Syllabus for Petrology

Course: Petrology, GEO-320, Tu-Th 9:00-10:45, lab Tu 1:55-4:40
Professor: Kurt Hollocher
Petrology web site: https://muse.union.edu/hollochk/kurt-hollocher/petrology/
Office hours: by appointment or just drop by any time.
Textbooks: Petrology, by Blatt, Tracy, Owens, 3nd ed., and your mineralogy book

Course Outline

Section	Month	Date	Subject
Igneous rocks	March	29	Igneous rocks: identification and classification, optical review
		31	Igneous rocks: tectonic settings, field relations, processes
			Lab: Igneous minerals in thin section
	April	5	Binary liquidus systems
		7	Ternary liquidus systems
			Lab: Igneous rock textures and sample descriptions
		12	More ternary liquidus systems, magmatic geochemistry
		14	More magmatic geochemistry
			Lab: Comparing felsic plutonic series
		19	Magmatic geochemistry: trace element models
		21	Magmatic geochemistry: the lanthanides, ocean ridges
			Lab: Comparing mafic cumulates
		26	Arc volcanism
		28	Arc and hot spot volcanism
			Lab: Iceland volcanics
	May	3	Igneous rock exam
Metamorphic rocks		5	Metamorphic rocks: tectonic settings, field relations
			Lab: Metamorphic minerals in thin section
		10	Metamorphic rocks: classification, facies, isograds, fabrics
		12	The phase rule and reactions in P-T space
			Lab: Western New England mafic volcanics
		17	Petrogenetic grids, binary systems, petrographic textures
		19	Petrographic textures and interpretation
			Lab: Western New England pelites
		24	Reactions in P-T space: ternary systems, projection
		26	Reactions in P-T space: quaternary systems, projection
			Lab: Western Norway high pressure rocks
		31	Metamorphic assemblages in P-T space, mafic and pelitic rocks
	June	2	Geothermometry and geobarometry
			Lab: Fault rocks
		??	Metamorphic rock exam

Introduction

Rocks can tell stories about their geologic history. The stories are written in a language of rock chemistry, mineralogy, textures, and mineral chemistry. In this course we will study this language and read some of the stories contained in igneous and metamorphic rocks. To do so, we will use several theoretical and mechanical devices, including the most basic and powerful of all petrographic tools: the polarized light microscope. Rocks are divided into three categories based on the principal geologic processes that form them:

- Melting within the earth, movement of the liquids, and their crystallization below and on the surface: these processes form igneous rocks.

- Change of rocks under the influence of heat, pressure, chemical flux, and differential stress: these processes form metamorphic rocks.
- Weathering, transport, and deposition of materials at or near the earth's surface: these processes form sedimentary rocks.

On our dynamic planet there is constant cycling between these three broad categories of rocks. This course involves the petrology of igneous and metamorphic rocks. Because rocks are aggregates of minerals, this course is a natural continuation of Mineralogy. You will learn to recognize, describe, and classify many rocks in both hand sample and thin section. With practice, your skills at hand specimen identification and optical mineralogy will improve dramatically. In addition, you will learn about many aspects of mineral textures, process, occurrences, and principles that will allow you to interpret parts of the geologic record held in igneous and metamorphic rocks. Lab work, principally the study of rock hand samples and thin sections, is a major focus of the course that will require individual work outside of lab time.

Petrology can be tough stuff, but it is a powerful and rewarding tool. Petrologic concepts are valuable not only in geology, but have direct applications in ceramics, metallurgy, and other aspects of materials science. Petrologic concepts may initially be difficult to grasp if you are first exposed to them in class. Please be prepared by reading the text and doing any requested introductory work. Warning: getting behind in Petrology can be detrimental to your physical and mental well-being.

All day field trips

The plan is for two all-day weekend field trips: one across the Taconian orogen in New York and northern Massachusetts, and one to the eastern Adirondacks and high peaks region. You are expected to attend both trips. Both trips will leave Union College at 6:00 AM sharp at the Olin Building traffic circle, and return at ~8:00 PM. We will be out in the open for extended periods and your comfort and safety require shoes and clothing appropriate for the conditions. All field trips will travel to moderately high elevations, so cold weather, wind, and rain should be expected.

If you miss a trip you will have to write a paper instead. I assume that field trip participants get the full benefit from the trip (must actually participate, not sleep all day in the van). Papers, on the other hand, will be graded for scientific content and writing quality.

Basis for the course grade

If you have to miss a class or lab for some valid (e.g., medical) reason, let me and the Dean of Students office know beforehand to make alternative arrangements, *as per Union College policy*. Follow whatever Covid-19 policies are presently active, too.

Work type	Proportion of grade
Homework, readings	21 %
Labs	36 %
Field trip/paper	3 %
Igneous rock exam	20 %
Metamorphic rock exam	20 %
Total	100 %

Readings

You don’t need to read the chapters on sedimentary rocks, but they may be valuable in your professional future, and could be useful as a reference during the metamorphic rock section. In addition to the text, there are copies of various petrology, mineralogy, and optical mineralogy books, thin section atlases, and lab manuals available in 332. Please use these as references as needed. It is very important that you complete the readings (and other assignments) on time.

Week	Chapters in BTO
1	1, 2, 3, Appendix 1
2	4, 5
3	6, 7
4	8, 9, Appendix 4
5	10
6	17, 18
7	19, 20, Appendix 2
8	21, 22
9	23, Appendix 3
10	-

Extra help

For extra help see me. I am generally available and I can always make appointments. I can even schedule weekly or more frequent regular appointments to give extra help to individuals or small groups.

Learning outcomes

In this course you will learn about the origin and development of common igneous and metamorphic rocks. This will include theory, and looking at thin sections and hand samples. You will learn to evaluate igneous rock chemical compositions and mineralogy in terms of progressive magmatic processes, and use metamorphic rock mineralogy and textures to evaluate them in terms of development..

The following is academic boilerplate, important though not specific to this course

Most of the following is verbatim from Union College documents. Preexisting disabilities, mental health problems, and serious illness should not be ignored or hidden. They can lead to serious difficulties in your academic career, and elsewhere in your life. These services are here for you to use as necessary. Do so. Academic misconduct is a somewhat different matter. Do not copy the work of others without attribution. In this course, you may talk to and work with your fellow students on any and all homework and projects, but what you turn in must be written or otherwise produced by you, including figures and tables. More details below.

Reading, class attendance, turning in work

All students are expected to attend all classes and labs. If attendance is impossible for some reason, materials will be made available on-line, so you will still be responsible for all work (readings, labs, tests), on which your grade will be based. All assignments, including labs, will be due Saturday noon the same week each lab takes place. *Can't turn it in by then? Get it in earlier!* If you have to miss a class, quiz, exam, or lab for some valid reason (e.g., you being quarantined), let me *and* the Dean of Students office know beforehand to make alternative arrangements. I can't make arrangements after the fact without a valid excuse through the Dean of Students office. Sorry folks, just following College policy.

This not a fast-paced or particularly difficult course, but it is a fast-paced 10-week term. Because of that, late work will generally not be accepted, except as recommended by Deans. Get work in on time!

Specifics for medical issues: If you have to or have missed or may miss a class, lab, or homework deadline because of illness, go to the Wicker Wellness Center, or send them the relevant medical documentation (fax to 518-388-6147, email to uchealthcenter@union.edu, web site: https://www.union.edu/health-services). The Wellness Center will make an evaluation. They may or may not send that information on to the Dean of Students, with your permission, but if you are sick you should certainly see someone. Wear your masks, etc., and try not to get sick.

Extra help

For extra help there is always me, of course. I will have office hours and I can make Zoom or in-person appointments (in-person will require masks etc.). I can even schedule weekly or more frequent regular appointments to give extra help to individuals or small groups. Geoscience majors may be hanging out on the 3rd floor of Olin, and are mostly harmless, and can also be quite helpful (masks etc. required, as usual).

Recommended on-line classes boilerplate

"*If you are quarantined or isolated for COVID-19-related reasons, I will be notified by the Dean of Students Office that you may require flexibility with regard to your participation in this course. Your responsibility will be to contact me as soon as you are able so that we can discuss your needs. If you are not able to keep up with the course in real time, I will make arrangements to provide you with full course material missed from classes.*"

In addition, all materials will be available on Nexus or the class web site, and all Zoom classes and labs, if we have to do any, will be recorded and available. That means you can be away or out of touch for a while, and still turn in the work. Do so.

Learning or other disabilities

From the Union College Student Handbook: "*Students seeking reasonable accommodations should be aware that it is their responsibility to...request accommodations from the Director [of Student Support Services] in person with at least two (2) weeks notice of the accommodation needed.*" Contact them directly: Accommodative Services Office, 388-8785, mailto:shinebas@union.edu. No accommodations can be provided without a letter or card from the Accommodative Services Office. You talk the them, they will notify me. You should also talk to me, too, to make sure I am aware of (or remember) the issue so we can arrange things appropriately.

Academic misconduct

You will sometimes work in small groups, but *all work that you hand in must be your own!* No copying or otherwise duplicating lab reports or computer-generated figures. No giving or accepting access to old course materials. This and all other forms of plagiarism, cheating, destruction of resource materials, and other forms of academic dishonesty will be referred immediately to the Dean of Studies, as per *Union College policy*.

We have an Honor Code at Union College. Here is the "model statement" that I have been asked to place right here in this very spot:

"Union College recognizes the need to create an environment of mutual trust as part of its educational mission. Responsible participation in an academic community requires respect for and acknowledgement of the thoughts and work of others, whether expressed in the present or in some distant time and place. Matriculation at the College is taken to signify implicit agreement with the Academic Honor Code, available at honorcode.union.edu. It is each student's responsibility to ensure that submitted work is his or her own and does not involve any form of academic misconduct. Students are expected to ask their course instructors for clarification regarding, but not limited to, collaboration, citations, and plagiarism. Ignorance is not an excuse for breaching academic integrity. Students are also required to affix the full Honor Code Affirmation, or the following shortened version, on each item of coursework submitted for grading: 'I affirm that I have carried out my academic endeavors with full academic honesty.'"

Signed
Whoever you are

Note that, if you forget to *"...affix the full Honor Code Affirmation,* or *this shortened version, on each item of coursework submitted for grading: "I affirm that I have carried out my academic endeavors with full academic honesty."*, I will assume that you meant to.