ERTH2104 Winter 2024

Igneous Systems, Geochemistry and Processes

Instructor: Brian Cousens

Igneous Petrology is the study of processes that produce melts (magmas) within the Earth, how these magmas then rise towards the surface, the chemical and mineralogical changes that occur as they cool and crystallize, how magmas interact with crustal rocks through which they pass, and how different rock formations are produced during eruption or emplacement of magmas. We will discuss how the chemistry of igneous rocks depends on the composition of the source material that is melting, and how this primary melt composition can change as a result of the many processes that occur after this melt separates from its source and ascends through the Earth's mantle and/or crust. Note that the best approach to understanding igneous rocks involves field, chemical, and textural analysis. Volcanic eruptions are significant hazards to people and property, so a thorough understanding of volcanic processes is critical to assessing volcanic hazards. Igneous rocks are also important hosts for critical mineral deposits, such as Cu, Pb, Zn, Mo, Ag, Au, and other elements. We will also further investigate the links between igneous rocks and tectonic setting that were introduced in ERTH 1006. The Rock Assignment is a comparative petrographic and geochemical study of two suites of volcanic rocks that simulates a real-world research project.

Includes: Experiential Learning Activity
Prerequisites: (CHEM 1001 or CHEM 1005) and (CHEM 1002 or CHEM 1006), (MATH 1004 or MATH 1007), (MATH 1104 or MATH 1107) and ERTH 2102 Mineralogy to Petrology.

Lecture: Wednesday and Friday 2:30 - 4:00 PM, HP 3120, ***in-person only***
Labs: Tuesday OR Friday 8:30 – 11:30AM, HP 2120, ***in-person only***

Grading Scheme:

Lecture	Mid-term Exam	10%
	Final Exam	25%
Rock Assignment		25%
Lab	Lab Quizzes (weekly)	15%
	Final Lab exam	25%

Textbook: Winter, JD, 2010. Principles of Igneous and Metamorphic Petrology, 2nd Edition. Prentice Hall. *Out of print.* PDF-version at: https://www.geokniga.org/bookfiles/geokniga-principlesofigneousandmetamorphicpetrologybyjohndwinterz-liborg.pdf

Websites:

http://www.alexstrekeisen.it/english/

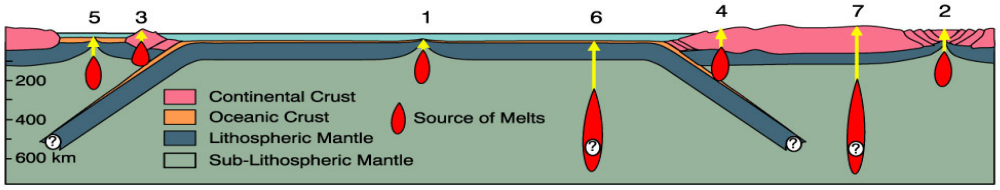
Brightspace: Lecture slides, and other materials, will be posted on the Brightspace learning management system. The Lab Manual will also be posted online, but lab exercises will be assigned at the beginning of each lab period.

Office Hours: by appointment only.

How to get in touch: Office: HP 2259
e-mail: brian.cousens@carleton.ca

Topics To be Covered:

The Earth and Magma Generation
Igneous Rock Names and Textures
Field Relationships
Thermodynamics and Phase Diagrams
Geochemistry of Igneous Rocks
Igneous Rocks and Plate Tectonics
Mantle Melting and Basaltic Rocks
Evolution of Magmas
Layered Intrusions and Anorthosites
Oceanic Volcanism
Large Igneous Provinces
Convergent Margin Magmatism
Granitoids
Alkaline Rock Suites, Kimberlites and Carbonatites



ERTH2104 Learning Outcomes:

By the end of the semester, each successful student will acquire the following skills and knowledge sets in the lecture and laboratory sessions:

- Describe and summarize the field characteristics, chemical and mineralogical composition, and petrogenesis of the major igneous rock groups and deduce their plate tectonic association and mode of origin.
- describe the various mechanisms by which Earth materials melt to form magmas, and describe processes that modify those magmas as they pass through the lithosphere.
- employ the key skills used to aid the interpretation of igneous rocks using geochemical diagrams, in particular igneous phase diagrams.
- identify the common rock forming minerals of igneous rocks in both hand specimen and thin-section through practical experience using a transmitted light microscope.
- identify key textural features of igneous rocks in both hand specimen and thin-section, and appreciate the significance of such features with regard to geological processes that have operated.
- Classify and name an igneous rock on the basis of its mineralogical and textural characteristics, and appreciate the environment(s) of formation.
- Describe rocks in thin-section and summarize and interpret the salient features.
- organize petrographic and geochemical information to determine the origin of rock suites, in a class "rock project" involving both individual and group work.

STUDENT ACCOMMODATIONS

Examinations and Assignments

Unless caused by illness, all conflicts **MUST** be reported to the instructor **PRIOR** to the exam date. If a lab is missed, a student may make it up along with the lab quiz in another lab section during that week. Please **STAY HOME** if you do not feel well. In the case of illness on an exam date (e.g., cold, flu), I require that you inform me by e-mail immediately, and we will schedule a deferred exam as soon as possible. In the case of a serious illness, see **https://carleton.ca/registrar/deferral/** for the rules concerning deferral of an exam or assignment, and contact me as soon as possible.

Requests for Academic Accommodation

You may need special arrangements to meet your academic obligations during the term. For an accommodation request, the processes are as follows:

Pregnancy obligation
Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website: **carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf**

Religious obligation
Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website: **carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf**

Academic Accommodations for Students with Disabilities
If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or pmc@carleton.ca for a formal evaluation or contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with your instructor as soon as possible to ensure accommodation arrangements are made. **carleton.ca/pmc**

Survivors of Sexual Violence
As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and is survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: **carleton.ca/sexual-violence-support**

Accommodation for Student Activities
Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. **https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf**

For more information on academic accommodation, please contact the departmental administrator or visit: **students.carleton.ca/course-outline**

Medical Certificates

Please note that in this course medical certificates are not required. If you are sick, **stay home** and get better! But I **must** be informed as soon as possible, and any missed deadlines (assignments, midterm exam) must be made up as quickly as possible.

PLAGIARISM

The University's Senate defines plagiarism in the regulations on instructional offences as: "to use and pass off as one's own idea or product work of another without expressly giving credit to another". ***This includes copying of material from websites or other publications that is incorporated into assignments, reports, or other submissions for grading.*** Borrowing someone else's answers, unauthorized possession of tests or answers to tests, or possession of material designed in answering exam questions, are all subject to university policy regarding instructional offences.

For this course (and all other courses at Carleton), it is extremely important to understand that you cannot copy and paste material from websites or publications into assignments. This is plagiarism, and it is easy to spot during grading of weekly assignments. When formulating an answer to an assignment question, be sure to reword the material from websites or publications into your own words, then type that into your assignment and cite the source of your information. Identification of copied material in an assignment answer will result in an automatic zero points for that assignment. A second offense will be reported to the Dean of Science office.

I encourage students to work together on assignments. HOWEVER, each student MUST submit answers to questions ***in their own words***, not the words used by another student that you are working with. ***Be sure that you and your co-worker word your submitted answers differently.*** If the answers submitted by one student for an assignment are identical to those submitted by another student, both students will be assigned a grade of zero for the question.

Details regarding the Carleton University Academic Integrity policy can be found at: https://carleton.ca/registrar/academic-integrity/ .