

ERTH2104 Winter 2022

Igneous Systems, Geochemistry and Processes

Instructor: Brian Cousens

Igneous Petrology is the study of processes that produce melts (magmas) within the Earth, how these melts 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. We will also further investigate the links between igneous rocks and tectonic setting that were introduced in EARTH 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 EARTH 2102 Mineralogy to Petrology.

**Lecture:** Monday and Wednesday 2:30 - 4:00 PM, HP 3120, *in-person only*\*

**Labs:** Monday or Wednesday 8:30 – 11:30AM, HP 2120, *in-person only*\*

*\*Lectures and labs will be held ONLINE from January 10-28, 2022.*

**Covid-19 Requirements**

Carleton University requires **mandatory vaccination** against COVID-19 for all students, teaching assistants and instructors participating in any in-person university activities. Since both lectures and labs in this course are in-person, **only fully vaccinated students may participate in EARTH 2104.**

Individuals **must attest to receiving their first dose of vaccine by September 8, 2021, with a second dose no later than October 15, 2021.** For more information, visit: <https://carleton.ca/covid19/health-and-safety/covid-19-vaccines/>.

**cuScreen:** Students must sign into the Herzberg Building using cuScreen. You must also log in to HP 2120 at the beginning of every lab and log out of the room when you leave. All students must wash their hands in the lab prior to starting the lab.

### **General Safety Measures**

All members of the Carleton community are required to follow general COVID-19 prevention measures and all mandatory Ontario Public Health requirements, since the course is in-person. This includes wearing a well-fitted mask that covers the nose, mouth and chin at all times; physical distancing; bring your own hand sanitizer; practise proper hand hygiene, respiratory and cough etiquette; mandatory self-screening prior to coming to campus daily; and using the QR codes when entering/exiting the class. When in class or in a lab, students **must** maintain a minimum of 2-metre distance apart. A hand must be raised to signify the need for help. *I especially emphasize that students, TA's or instructors should not come to campus if they feel unwell.*

In the case of classes or meetings being held on-campus in our lecture rooms or teaching labs, you must follow the COVID-19 screening protocols established by the University: use cuScreen to request access to campus and self-declare your health status, wash hands upon entering the Herzberg Building, and scan QR Codes in your path as you progress towards your lab room. For details, please review the Return To Campus COVID-19 Teaching Labs and General Policies forms, and watch the lab protocols video at:

<https://earthsci.carleton.ca/return-to-campus-2021/>

For the most recent information on COVID-19 protocols, visit: <https://carleton.ca/covid19/policies-and-protocols/>.

### **Grading Scheme:**

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

**Textbook:** Winter, JD, 2010. Principles of Igneous and Metamorphic Petrology, 2<sup>nd</sup> Edition. Prentice Hall. Available in the Bookstore.

### **Websites:**

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

**Microscopes in EARTH 2104 labs:** To minimize the risk of COVID-19 transmission via microscopes, all of the eyepieces on the microscopes have been removed. Instead of looking down the microscope, all students will use an AmScope camera to view thin sections under the microscope. In order to use the camera, you will need a laptop with a USB-2 connection. Various versions of the required software for Windows, Mac and Linux operating systems are available at <https://amscope.com/pages/software-downloads> (click on Camera, and the model is MD500L). Each camera box comes with a CD that includes a users manual, which you are free to download. If you do not have a CD drive, then I have a pdf version that I will make available

on Brightspace. If you do not have a laptop, the department will provide one for the lab session that already has the software and users manual installed on it. The advantage of the camera is that you can take photos of key textural and mineralogical characteristics of each thin section that you look at. All photos taken MUST be downloaded at the end of each lab. At the end of each lab session, students must clean their microscopes (touched surfaces, including the focus knobs, on-off switch, stage) before leaving the lab.

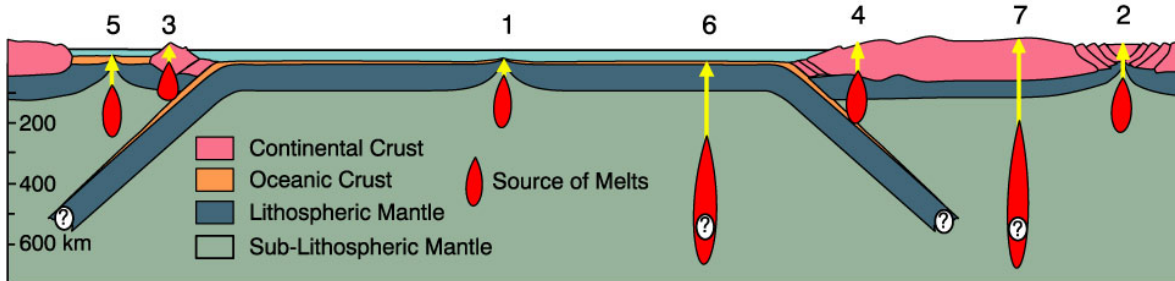
**Brightspace:** Lecture slides, and other materials, will be posted on the Brightspace learning management system. The Lab Manual will also be posted online, but lab exercises will be assigned at the beginning of each lab period.

**Office Hours:** by appointment only, via Zoom.

**How to get in touch:** Office: HP 2259  
Office Phone: x4436  
e-mail: [brian.cousens@carleton.ca](mailto: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**

Students with conflicts for any examination must have a note from an employer or a sports coach in order to **write the exam** at another date. 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 a less serious illness (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](https://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](https://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](mailto: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](https://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](https://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](https://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/>.