

## **ERTH 2104 - Igneous Systems and Processes - Winter 2023**

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 EARTH1006. The Rock Assignment is a comparative petrographic and geochemical study of two suites of volcanic rocks that simulates a real-world research project.

### **Course Description:**

The sources and magmatic evolution of volcanic and plutonic rocks systems, with emphasis on geochemical, mineralogical, and textural characteristics, and relations to igneous processes.

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.

Lectures three hours a week, laboratory three hours a week and a field excursion.

## **Topics To be Covered (Schedule TBA):**

- 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

## **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.
- create detailed and annotated petrographic sketches from thin-section observation and to summarise 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.

**Times and Location:**

*Lectures:* to be delivered in-person 14:30 to 16:00 Mondays and Wednesdays in Room 3120 HP. There is no online component

*Laboratories:* 8:30-11:30 Fridays and 14:30-17:30 Tuesdays in Room 2120 HP. Attendance is mandatory.

*Class Schedule:* TBA and posted on BrightSpace

**People:**

- *Instructor:* Chris Rogers
  - Office hours: TBA or by appointment
  - Email: [chris.rogers@carleton.ca](mailto:chris.rogers@carleton.ca)
  - For privacy reasons I only respond to emails sent through the Carleton University email system. *No Gmail, Hotmail etc*
- *Teaching assistants:* TBA
  - Office hours: TBA

**Textbooks:**

- *Recommended Reading:*
  - Winter, J., 2010. An introduction to igneous and metamorphic petrology. Prentice Hall, Upper Saddle River, NJ, United States.
- *Websites:*

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

**Online Resources:**

This document is available on BrightSpace as are many others relevant to the course. Frequently, visit the homepage of this course for updates with respect to the course plan. The course plan contains information on lecture and laboratory topics, reading assignments, homework, and pre-lecture as well as pre-lab preparations. Note that this course plan may alter during the term. The course website contains most of the laboratory assignments and homework, and you will have to print and read them carefully before the respective labs and lectures. Lectures and lecture notes will be made available after each lecture.

### **Course requirements:**

You are expected to attend all lectures and laboratories.

### **Grading:**

32% Laboratory exercises (@4% each)

10% Mid-term Exam

10% Class participation

15% Rock project

8% Center for Student Academic Support Incentive Program

25% Final Exam

\*\*\*The lab component of the course must be passed in order to pass the course.

Laboratory exercises will be due 1 week after it is assigned. Late labs will be penalized 15% per day for a maximum of 3 days.\*\*\*

### **Incentive Program Syllabus Information**

This course has been registered in the Incentive Program offered through the Centre for Student Academic Support (CSAS). The Incentive Program is now fully online! CSAS Learning and Writing Support Workshops are designed to help students cultivate and refine their academic skills for a university environment. To earn 10% towards attendance/participation, students are expected to complete 4 workshops throughout the term.

*The workshops must be completed by April 12<sup>th</sup> to receive credit for the Incentive Program.*

Please ensure that you complete the workshops by your course-specific deadline.

For students' attendance to be captured, they must complete all workshop components and achieve 100% on the final assessment. Once students achieve 100% on the final assessment, they will receive a Record of Completion award from Brightspace. Students will need to download the Record of Completion PDF for each applicable workshop and submit them to the assignment submission box within their instructor's course. For more information about workshop attendance and submitting the Records of Completion, please visit the Incentive Program Policies on our website.

To view the complete list of the workshops and their descriptions, please visit the Learning and Writing Support Workshops page on the CSAS website (<https://carleton.ca/csas/incentive-program/>).

Please note that CSAS webinars and in-person workshops are not eligible for the Incentive Program.

For complete workshop descriptions please visit the CSAS website:

<https://carleton.ca/csas/learning-support-workshops/> .

To access the online workshops, please self-enroll through the CSAS Online Learning Community: <https://carleton.ca/csas/online-support/>

For additional questions, please contact the Centre for Student Academic Support at [csas@carleton.ca](mailto:csas@carleton.ca).

### **Academic Integrity at Carleton**

Carleton University demands academic integrity from all its members. It is your responsibility to review Carleton's policy on Academic Integrity. The Academic Integrity Policy (<http://carleton.ca/secretariat/wp-content/uploads/Academic-Integrity-Policy.pdf>) governs the academic behaviour of students. Academic Integrity is defined as:

“A commitment even in the face of adversity to five fundamental values: honesty, trust, fairness, respect, and responsibility.” – Centre for Academic Integrity (1999)

Academic dishonesty, in whatever form, is destructive to the values of the university, and risks harming the university's reputation as place of learning and innovation. Furthermore, it is unfair and discouraging to those students who pursue their studies honestly.

Process

The Academic Integrity Policy is implemented at the faculty level across the university. Appeals of the Academic Integrity Policy are administered by the Director, Student Affairs.

Step 1: Instructor believes misconduct has occurred

Step 2: Faculty Dean reviews documentation

Step 3: Student is contacted by email and letter

Step 4: Meeting with student, Dean and Advisor

Step 5: Dean informs student of decision

Appeal: Student has the right to appeal the decision

### **Examples of Violations**

The following list includes, but is not limited to, examples of violations under the Academic Integrity policy. Please refer to the full Academic Integrity Policy (PDF) for more information.

#### **Plagiarism:**

The instructor is required to report all incidents (or suspected incidents) of plagiarism to the Dean. All work handed in must be your own work. The Policy is strictly enforced and is binding on all students.

Examples include:

- Submitting work written in whole or in part by someone else
- Failing to acknowledge sources through the use of proper citations when using another's work
- Test and Exam Rules:
  - Attempting to read another student's exam paper
  - Speaking to another student (even if subject matter is irrelevant to text)
  - Using material not authorized by the examiner

#### **Other Violations:**

- Improper access to confidential information such as exams or test questions
- Disruption of classroom activities or periods of instruction
- Misrepresentation of facts for any academic purpose

### **Examples of Sanctions**

The following list includes, but is not limited to, a few examples of sanctions that may be used independently or in combination, depending on the details of the academic integrity violation. Repeat or multiple violations will increase the sanction. Refer to the Academic Integrity Policy (PDF) for more information.

- A grade of zero, a failure or a reduced grade for the piece of academic work
- Reduction of final grade in the course
- Completion of a remediation process
- Resubmission of academic work
- Withdrawal from course(s)
- Suspension from a program of study
- A letter of reprimand

## **Academic Accommodations**

Carleton University is committed to providing access to the educational experience in order to promote academic accessibility for all individuals.

Academic accommodation refers to educational practices, systems and support mechanisms designed to accommodate diversity and difference. The purpose of accommodation is to enable students to perform the essential requirements of their academic programs. At no time does academic accommodation undermine or compromise the learning objectives that are established by the academic authorities of the University.

## **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:

### **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](http://carleton.ca/pmc)

### **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](http://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf)

For more information on academic accommodation, please contact the departmental administrator or visit: [students.carleton.ca/course-outline](http://students.carleton.ca/course-outline)

### **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](http://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf)

For more information on academic accommodation, please contact the departmental administrator or visit: [students.carleton.ca/course-outline](http://students.carleton.ca/course-outline)

### **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](http://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)