

ERTH 3003 - Geochemistry and Geochronology

Instructor: Hanika Rizo (she/her)

Email: hanika.rizo@carleton.ca

Note: if you have a question or would like to talk with me, feel free to stay after the lecture. Alternatively, you can reach out via email, and we can arrange a convenient time for an in-person or virtual meeting.

Lectures: In-person, 3120 HP.

3h/week, Monday 11:35-14:25.

First class Sept. 11, 2023.

Labs: In-person, 3120 HP

2h/week, Thursday 12:35-15:25.

First lab Sept. 14, 2023.

Prerequisites: ERTH 2102 (mineralogy to petrology), 2104 (igneous systems, geochemistry and processes) and 2105 (geodynamics).

Course TAs:

Alexandre Rouleau

AlexandreRouleau3@cmail.carleton.ca

Student hours: TBD. Student hours are designated time slots throughout the week for you to connect with our TAs. Feel free to drop by, introduce yourself, inquire about the course, or delve into any course-related topics.

Welcome to this Course!

This course explores geochemical processes from deep Earth to surface environments, and the use of isotopic variations to define geochronological frameworks and geochemical pathways, in order to better understand the Earth's history.

Learning outcomes

By the end of the course, students will be able to:

- Describe how different chemical elements behave and are distributed in multiple geological environments
- Assess current theories of Earth's differentiation into core, mantle, crust, as well as the origin of oceans and the atmosphere
- State several geochronological techniques and their applications
- Apply the principles of elemental and isotopic fractionation to investigate several geological processes.

Inclusive teaching statement

We are committed to fostering an environment for learning that is welcoming and inclusive for everyone. In our course, we will seek to behave with the following values (*adapted from the International Center for Academic Integrity*): honesty, responsibility, respect, fairness, trust and courage.

Course topics and plan (might change during the semester)

Week	Lectures (11:35-14:25)	Labs/Lectures (12:35-14:25)
Sept. 11	Intro to geochemistry, properties of elements, the periodic table	Lab #1. Chemistry review
Sept. 18	Nucleosynthesis, origin of the elements, planetary accretion	Lab #2. Bulk Earth vs. Bulk Silicate Earth
Sept. 25	Geochemical reservoirs I. Composition of core and mantle	Lab #3. Earth's geochemical reservoirs
Oct. 2	Geochemical reservoirs II. Composition of crust and hydrosphere	*Lecture: Trace elements (igneous processes mixing, weathering)
Oct. 9	Statutory Holiday. No class on Monday Oct. 9 th .	Lab #4. Geochemistry of igneous processes
Oct. 16	(cont.) Trace elements	No lab. Midterm Exam prep.
Oct. 23-27	Fall Break, no classes	
Oct. 30	Midterm Exam Monday Oct. 30 th	No lab. Exam review and feedback.
Nov. 6	Introduction to geochronology I	Geochronology lab I
Nov. 13	Introduction to geochronology II	Geochronology lab II
Nov. 20	Geochemistry project	Geochemistry project
Nov. 27	Geochemistry project	Geochemistry project Deadline Friday Dec. 1 st
Dec. 4	Low temperature geochemistry	*Lecture: Stable isotope geochemistry
Dec. 11-22	Final exams, scheduled by University later during the semester.	

Useful Resources

Books

- Faure, G., 1998. Principles and Applications of Geochemistry: a comprehensive textbook for geology students. Prentice-Hall.
- White, W.M., 2013. Geochemistry. John Wiley & Sons, Inc. (Also available as an e-book).
- Albarède, F., 2013. Geochemistry; An Introduction. Cambridge University Press. (Also available as an e-book).
- Dickin, A.P., 2005. Radiogenic Isotope Geology. Cambridge University Press. There is an online version of his radiogenic isotope textbook here:
<http://www.onafarawayday.com/Radiogenic/>

Websites

Webelements: <http://www.webelements.com/>

Geochemical Earth Reference Model (GERM): <http://earthref.org/GERM/>

Brightspace: Course lecture slides and labs (assignments) will be posted on Brightspace. All information concerning the course, including assignments, will also be posted on the site. Note that posting of pdf copies of journal articles on Brightspace is a violation of copyright regulations. However, all students have access to journal articles via the library electronic subscriptions and each student is allowed one copy for personal use.

Course requirements:

- All lectures and labs are mandatory.
- You will usually have 1 week to complete each assignment. Failing to hand in assignments by the deadline will result in 10% reduction of your mark on the specific assignment per day, for three days. After that, a mark of zero on the specific assignment.
- You must inform us immediately (3 days maximum) of any medical issue that causes a delay in completing an assignment or an exam. We will then agree on how to make up for the missed deadline.

Assessment in this Course

Research about learning strongly suggests that the most important factor in learning is doing the work of reading, writing, recalling, practicing, synthesizing, and analyzing. Learning happens best when people actively engage material on a consistent basis, and that is why we have high standards in this course. We are confident that, with appropriate effort, you all can meet those standards.

We also make an effort to reduce unintentional bias in grading by, for example and when possible, grading assignments one question at a time (grading all of question 1 before grading any of question 2), grading anonymously, and using rubrics.

Grade Breakdown

Midterm Exam (in-person)	30% - Monday October 30 th
Final Exam (in-person)	30% (not cumulative; December exam period)
Assignments (n=6-7)	26%
Geochemistry project	14%

Note About COVID-19 & Mental Health

The global pandemic has led to extra stress and uncertainty for everyone, and while we may all be experiencing the same storm, this does not mean that we are all in the same boat! If you are struggling, please do not hesitate to reach out. I am happy to listen, and/or direct you to resources that might help. In terms of class, if you need extra help or missed a lesson, don't stress! Email me and we will set a time to meet. I'll work with you, I promise. Remember that Carleton also offers an array of mental health and well-being resources, which can be found [here](#).

University Policies

In accordance with the Carleton University Undergraduate Calendar Regulations, the letter grades assigned in this course will have the following percentage equivalents:

A+ = 90-100	B+ = 77-79	C+ = 67-69	D+ = 57-59
A = 85-89	B = 73-76	C = 63-66	D = 53-56
A- = 80-84	B- = 70-72	C- = 60-62	D- = 50-52
F = <50			

WDN = Withdrawn from the course

ABS = Student absent from final exam

DEF = Deferred

FND = (Failed, no Deferred) = student could not pass even with 100% on final exam

Academic Accommodations, Regulations, Plagiarism, Etc.

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. More information can be found at: <https://students.carleton.ca/course-outline/>

University rules regarding registration, withdrawal, appealing marks, and most anything else you might need to know can be found on the university's website, here:

<https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/>

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. For more details, visit the [Paul Menton Centre website](#).

Addressing Human Rights Concerns

The University and all members of the University community share responsibility for ensuring that the University's educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the [Department of Equity and Inclusive Communities](#) at equity@carleton.ca.

Religious Obligations

Please contact me 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, please review the [Student Guide to Academic Accommodation \(PDF, 2.1 MB\)](#).

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 where 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: <https://carleton.ca/sexual-violence-support/>

Accommodations for Missed Work

Carleton recognizes that these are unprecedented times during the COVID-19 pandemic, and that students may be experiencing greater stress and other life factors that are not in their control. As a result, Carleton has put into place a protocol for

students to apply for accommodations using a self-declaration form in the event of missed work. The form can be found at: <https://carleton.ca/registrar/wp-content/uploads/self-declaration.pdf>

For Pregnancy

Please contact me 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, please review the Student Guide to Academic Accommodation (PDF, 2.1 MB).

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 me 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, see the Senate Policy on Accommodation for Student Activities (PDF, 25KB).

Academic Integrity

Academic misconduct undermines the values of honesty, trust, respect, fairness, and responsibility that we expect in this class. Carleton University provides supports such as academic integrity workshops to ensure, as far as possible, that all students understand the norms and standards of academic integrity that we expect you to uphold. Your teaching team has a responsibility to ensure that their application of the Academic Integrity Policy upholds the university's collective commitments to fairness, equity, and integrity.

(adapted from Carleton University's Academic Integrity Policy, 2021).

Examples of actions that do not adhere to Carleton's Academic Integrity Policy include:

- Plagiarism
- Accessing unauthorized sites for assignments or tests
- Unauthorized collaboration on assignment and exams

Sanctions for not abiding by Carleton's Academic Integrity Policy

A student who has not adhered to Carleton's Academic Integrity Policy may be subject to one of several sanctions:

1. If you take full responsibility for your actions, and it is the first time you have violated the policy, you will receive zero on the assessment. If you are found to have violated the policy but do not take responsibility, an additional grade deduction will be applied (e.g. an A- will become a B+)
2. Subsequent violations of the policy may result in more severe sanctions such as failing the course, suspension from all studies and/or expulsion.

Process of an Academic Misconduct Investigation

Step 1: The instructor believes misconduct has occurred and submits documentation to the Dean of the Faculty of Science.

Step 2: The Dean reviews documentation and can proceed with or dismiss the allegation.

Step 3: If sufficient evidence, the student receives an allegation statement by email. Ombuds services is copied on the email.

Step 4: The student provides a written response to the evidence provided.

Step 5: Either party may request a meeting between student, dean, and the ombudsperson.

Step 6: Dean informs the student of the decision.

Appeal: Student has the right to appeal the decision.

Additional details about this process can be found on [the Faculty of Science Academic Integrity website](#). Students are expected to familiarize themselves with and follow the Carleton University [Student Academic Integrity Policy](#). The Policy is strictly enforced and is binding on all students.

Plagiarism

Plagiarism is the passing off of someone else's work as your own and is a serious academic offence. For the details of what constitutes plagiarism, refer [the Faculty of Science Academic Integrity website](#). To further understand Academic Integrity, consider attending the [Learning and Support Academic Integrity Workshop](#).

What are the Penalties for Plagiarism?

A student found to have plagiarized an assignment may be subject to one of several penalties including: expulsion; suspension from all studies at Carleton; suspension from

full-time studies; and/or a reprimand; a refusal of permission to continue or to register in a specific degree program; academic probation; award of an FNS, Fail, or an ABS.

What are the Procedures?

- 3.** All allegations of plagiarism are reported to the Dean of Faculty of Science. Documentation is prepared by instructors and/or departmental chairs.
- 4.** The Dean writes to the student and the University Ombudsperson about the alleged plagiarism.
- 5.** The Dean reviews the allegation. If it is not resolved at this level then it is referred to a tribunal appointed by the Senate.

Students are expected to familiarize themselves with and follow the Carleton University [Student Academic Integrity Policy](#). The Policy is strictly enforced and is binding on all students.

Assistance for Students

Academic and Career Development Services: <http://carleton.ca/sacds/>

Writing Services: <http://www.carleton.ca/csas/writing-services/>

Peer Assisted Study Sessions (PASS): <https://carleton.ca/csas/group-support/pass/>

Math Tutorial Centre: <https://carleton.ca/math/math-tutorial-centre/>

Science Student Success Centre: <https://sssc.carleton.ca/>