

Geochemistry and Geochronology

ERTH 3003 (Fall 2024)

Instructor: Hanika Rizo (she/her)

Email: hanika.rizo@carleton.ca

Office location: HP 2221

Lectures: In-person, 3120 HP.

2h/week, Monday 11:35-13:25.

First class Sept. 4, 2024.

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.

Labs: In-person, 3120 HP

2h/week, Thursday 15:35-17:25.

First lab Sept. 4, 2024.

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

Course TAs:

Matt Brenning (he/him)

MatthewBrenning@cmail.carleton.ca

Patrick Fraser (he/him)

PatrickMFraser@cmail.carleton.ca

Student hours: TBD. Student hours are designated time slots throughout the week for you to connect with our TA. 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

I am committed to fostering an environment for learning that is welcoming and inclusive for everyone. I will continually strive to create inclusive learning environments and would therefore appreciate your support and feedback. I welcome emails or in-person communications to let me know your preferred name or pronoun.

Land Acknowledgement

Here at Carleton University, it is important that we acknowledge that the land on which we gather is the traditional and unceded territory of the Algonquin nation.

Community Guidelines

The following values are fundamental to academic integrity and are adapted from the International Center for Academic Integrity*. In our course, we will seek to behave with these values in mind:

	As students, we will...	As a teaching team, we will...
Honesty	<ul style="list-style-type: none"> Honestly demonstrate our knowledge and abilities on assignments and exams Communicate openly without using deception, including citing appropriate sources 	<ul style="list-style-type: none"> Give you honest feedback on your demonstration of knowledge and abilities on assignments and exams Communicate openly and honestly about the expectations and standards of the course through the syllabus, and with respect to assignments and exams
Responsibility	<ul style="list-style-type: none"> Complete assignments on time and in full preparation for class Show up to class on time, and be mentally/physically present Participate fully and contribute to team learning and activities 	<ul style="list-style-type: none"> Give you timely feedback on your assignments and exams Show up to class on time, and be mentally & physically present Create relevant assessments and class activities
Respect	<ul style="list-style-type: none"> Speak openly with one another, while respecting diverse viewpoints and perspectives Provide sufficient space for others to voice their ideas 	<ul style="list-style-type: none"> Respect your perspectives even while we challenge you to think more deeply and critically Help facilitate respectful exchange of ideas
Fairness	<ul style="list-style-type: none"> Contribute fully and equally to collaborative work, so that we are not freeloading off of others Not seek unfair advantage over fellow students in the course 	<ul style="list-style-type: none"> Create fair assignments and exams, and grade them in a fair, and timely manner Treat all students equitably
Trust	<ul style="list-style-type: none"> Not engage in personal affairs while on class time Be open and transparent about what we are doing in class Not distribute course materials to others without authorization 	<ul style="list-style-type: none"> Be available to all students when we say we will be Follow through on our promises Not modify the expectations or standards without communicating with everyone in the course
Courage	<ul style="list-style-type: none"> Say or do something when we see actions that undermine any of the above values Accept a lower or failing grade or other consequences of upholding and protecting the above values 	<ul style="list-style-type: none"> Say or do something when we see actions that undermine any of the above values Accept the consequences (e.g., lower teaching evaluations) of upholding and protecting the above values

* This class statement of values is adapted from Tricia Bertram Gallant, Ph.D.

Assistance for Students

Career Services: <https://carleton.ca/career/>

Writing Services: <https://carleton.ca/csas/support/>

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/>

Online Community Expectations for Social Platforms

With the growing use of social platforms (e.g., Discord) on campuses, it is important to keep in mind that university codes of conduct still apply to the behaviours of students online. Please be considerate and respectful while engaging with peers and remember that we are all humans, and that your words matter. If any student witnesses or experiences harassment, I encourage you to reach out to me. Alternatively, you can contact [Ombuds Services](#) or [Carleton Equity and Inclusive Communities](#).

Online communities can be highly beneficial to students and can help to facilitate learning within the course. I encourage people to ask questions, learn from one another, and have open discussions about class material. That said, any acts of academic misconduct (i.e., cheating) will not be tolerated and will result in serious consequences ranging from a grade reduction to expulsion (see [academic integrity violations](#)).

- Examples of appropriate peer-to-peer sharing/learning vary from course to course. In this course appropriate peer-to-peer sharing includes: identifying the proper formula to use, identifying an incorrect or missing step in a person's work, brainstorming potential reasons behind a concept, suggesting helpful sites and videos for learning a concept, posting your own work showing only a specific step or process for illustrative purposes (note: this is very different from posting your work and solution for others to simply copy)
- Examples of unacceptable peer-to-peer sharing: Posting or sharing the answers, indicating which answers are correct on assignments, sharing links to solutions, posting your own complete work for a question/solution.

I encourage the group to come up with a **list of guidelines**, that moderators could re-post. Some ideas for suggested rules:

- Everyone should use their name and last name, avoiding inappropriate or offensive nicknames
- Moderators serve the right to change nicknames, delete or edit any posts
- No political, religious, or sexual discussions
- No bullying or harassment toward students, TAs, or instructors
- No racism sexism or hate speech of any kind
- Agree to disagree – allow others to express differing opinions and thoughts
- Etc.

Course topics and plan (might change during the semester)

Week	Lectures (11:35-13:25)	Labs (15:35-17:25)
Sept. 4	Intro to geochemistry, properties of elements, the periodic table	Lab #1. Chemistry review
Sept. 11	Nucleosynthesis, origin of the elements, planetary accretion	Lab #2. Bulk Earth vs. Bulk Silicate Earth
Sept. 18	Geochemical reservoirs I. Composition of core and mantle	Lab #3. Earth's geochemical reservoirs
Sept. 25	Geochemical reservoirs II. Composition of crust and hydrosphere	
Oct. 2	Trace elements (igneous processes mixing, weathering)	Lab #4. Geochemistry of igneous processes
Oct. 9	(cont.) Trace elements	No lab. Midterm Exam prep.
Oct. 16	Fall Break, no classes	Fall Break, no labs.
Oct. 23	Midterm Exam	No lab. Exam review and feedback.
Oct. 30	Introduction to geochronology I	Lab #5 Geochronology I
Nov. 6	Introduction to geochronology II	Lab #6 Geochronology II
Nov. 13	Geochemistry project	Geochemistry project
Nov. 20	Geochemistry project	Geochemistry project. Deadline Nov 22
Nov. 27	Low temperature geochemistry	No lab
Dec. 4	Stable isotope geochemistry	No lab
Dec. 9-21	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. **Feeling sick** (e.g., fever, chills, stomach upset) ? do not come to class – we can set up a zoom call so that you can join from home.
- 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

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% - Wednesday October 23 rd
Final Exam (in-person)	30% (not cumulative; December exam period)
Assignments (n=6-7)	25%
Geochemistry project	15%

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			
DEF = Deferred			

Mental Health

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](#).

Academic Accommodations, Regulations, Plagiarism, Etc.

Carleton is committed to providing academic accessibility for all individuals. You may need special arrangements to meet your academic obligations during the term. The accommodation request processes are outlined on the Academic Accommodations website (students.carleton.ca/course-outline)

- **Deferred/missed term work for short-term accommodation (5 days or less):** Submit a [self-declaration form](#), and send me a written email, and we can discuss of an appropriate accommodation (e.g., deadline extension).
- **Deferred/missed term work for longer term incapacitation (5 days or longer);** If you require accommodations for this course that are longer than the 5-day (short-term) period, please email me to discuss how/whether accommodation needs could be met for this course.

Statement on Chat GPT/Generative AI usage

AI Use in this course: Students may use AI tools for basic word processing and formatting functions, including:

- Grammar and spell checking (e.g., Grammarly, Microsoft Word Editor)
- Basic formatting and design suggestions (e.g., Microsoft Word's formatting tools, PowerPoint Design editor)

Documenting AI Use: It is not necessary to document the use of AI for the permitted purposes listed above. If you have questions about a specific use of AI that isn't listed above, please consult your instructor.

Why have I adopted this policy? This policy ensures that student voices and ideas are prioritized and authentically represented, maintaining the integrity of the work produced by students while allowing basic support to enhance clarity, correctness, layout, and flow of ideas. The goal of adopting a limited use of AI is to help students develop foundational skills in writing and critical thinking by practicing substantive content creation without the support of AI.

Academic Integrity

Academic Integrity is upholding the values of honesty, trust, respect, fairness, responsibility, and courage that are fundamental to the educational experience. 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
- Using artificial intelligence tools such as ChatGPT when your assessment instructions say that it is not permitted

Please review the checklist [linked here](#) to ensure you understand your responsibilities as a student with respect to academic integrity and this course.

Sanctions for Not Abiding by Carleton's Academic Integrity Policy

A student who has not upheld their responsibilities under Carleton's Academic Integrity Policy may be subject to one of several sanctions. A list of standard sanctions in science can be found [here](#).

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.

Student Rights & Responsibilities

Students are expected to act responsibly and engage respectfully with other students and members of the Carleton and the broader community. See the [7 Rights and Responsibilities Policy](#) for details regarding the expectations of non-academic behaviour of students. Those who participate with another student in the commission of an infraction of this Policy will also be held liable for their actions.

Student Concerns

If a concern arises regarding this course, **your first point of contact is me:** Email or pass by my office, and I will do my best to address your concern. If I am unable to address your concern, the next points of contact are (in this order):



Note: You can also bring your concerns to [Ombuds services](#).