

Faculty of Science Course Syllabus
Department of Earth and Environmental Sciences
ERTH 3020
Metamorphic Petrology
Winter 2025

Instructors: Lectures: James Brenan e-mail: jbrenan@dal.ca Office location: LSC-OCEAN 3612

Laboratory: Richard Cox e-mail: Richard.cox@dal.ca Office Location: LSC-BIO 3080

Lectures: Mon and Wed 13:05-14:35 Location: LSC-BIOL&EARTH B2020A

Laboratories: Thurs 1435-1725 Location: LSC-BIOL&EARTH B2020A

Office Hours: email me for an appointment, or come in if my door is open

Tutorials: none

Course Description

Metamorphic petrology is the study of the way in which pre-existing igneous, sedimentary, and metamorphic rocks respond to changes in pressure, temperature, and geochemical environment. Metamorphic reactions, deformation and recrystallization, the stability relations of minerals and mineral assemblages under various physical and chemical conditions, and the concept of metamorphic facies are discussed. The relationship of metamorphism to other geological processes is considered. In the labs, microscopic mineralogy and texture are used to decipher the metamorphic history of rocks.

Course Prerequisites

ERTH 3010

Course Objectives/Learning Outcomes

When you are done with this course, you should have the following competencies:

- 1) Identify, describe, and interpret metamorphic mineral assemblages and textures to identify protoliths and reconstruct metamorphic histories;
- 2) Interpret metamorphic textures in terms of formation conditions, kinematics, and overprinting relationships;
- 3) Apply principles of thermodynamics to interpret metamorphic reactions and phase diagrams;
- 4) Interpret metamorphic grade in terms of mineral assemblages, appropriate metamorphic facies or zones and spatial distribution of metamorphic isograds;
- 5) Calculate and interpret P-T-t conditions of metamorphism using microprobe data, thermobarometric calculations and petrographic observations;
- 6) Link metamorphic pressure-temperature-time-deformation paths to processes and tectonic settings of metamorphism.

Required Course Materials

A helpful textbook, that will be referred to in the lectures: John D. Winter "Introduction to Igneous and Metamorphic Petrology". Prentice Hall, 2nd edition, 2010 or 1st 2001. I will also be incorporating some

materials from the open access textbook entitled “Petrology: An introduction to Igneous and Metamorphic Rocks and Processes”, by Dexter Perkins. This can be accessed at: <https://opengeology.org/petrology/>. Other materials will be provided as pdf for download through Brightspace. The Laboratory Handbook is required and available for purchase at the Dal bookstore.

Course Assessment

Component (quantity)	% of final grade	Due Date(s)
Final Exam (1)	25%	Scheduled by the registrar
Midterm (1)	10%	12 February
Lab Midterm (1)	6%	6 February
Lab Final (1)	16.5%	3 April
Lab Assignments (9)	22.5%	weekly
Assignment 1: Thermal model	5%	TBD
Assignment 2: Monazite age	5%	TBD
Assignment 3: Thermobarometry	5%	TBD
Assignment 4: Western CBH	5%	TBD

Other course requirements

none

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

A+ (90-100)	B+ (77-79)	C+ (65-69)	D	(50-54)
A (85-89)	B (73-76)	C (60-64)	F	(<50)
A- (80-84)	B- (70-72)	C- (55-59)		

Course Policies

Late assignments will not be accepted, and will be given a mark of 0; Missed laboratory assignments will be given one week to hand in, and then will be considered late; Missed lab exams and class tests (mid term) will be made up at a mutually agreed date and time, but only if the student submits a valid Declaration of Absence form within the required reporting period. Otherwise, the exam will be given a mark of 0. Note that students are only allowed two submissions of this form, and otherwise the rules for submission of a valid doctor’s note are required. Unless otherwise indicated, all assignments are to be done individually without consulting other current or former class members.

Course Content

List of lecture topics

Date	Lecture Topic	Lab Topic
6, 8 Jan	Introduction; Controls of Metamorphism	Lab 1: Metamorphic Minerals
13, 15 Jan	P-T-t paths 1 and 2/ Assignment 1: Thermal models	Lab 2: Metamorphic Textures: Planar and Linear Fabrics
20, 22 Jan	Basics of Geochronology	Lab 3: Metamorphic Textures: Porphyroblasts and Porphyroclasts
27, 29 Jan	More geochron/Stable Mineral Assemblages 1/ Assignment 2: Monazite Age dating	Lab 4: Metamorphic Textures: Other Grain-Scale Textures

3, 5 Feb	Stable Mineral Assemblages 2/3	Midterm Lab Test
10, 12 Feb	Metamorphic Reactions; Midterm	Lab 5: Metabasites and Metamorphic Facies
17, 19 Feb	No Lectures (study break)	No lab (study break)
24, 26 Feb	Petrogenetic grids	Lab 6: Pelites
3, 5 March	Geothermobarometry 1/2	Lab 7: Calcareous, Quartzofeldspathic, and Other Rocks
10, 12 March	Geothermobarometry 3/Assignment 3: Thermobarometry	Lab 8: High-Grade Regional Metamorphism
17, 19 March	Metamorphism of mafic rocks 1/2	Lab 9: Ultra High Pressure Metamorphism
24, 26 March	Metamorphism of Calcareous and UM rocks 1	Assignment 4: Progressive metamorphism in the Western Cape Breton Highlands
31 March, 2 April	Metamorphism of calcareous and UM rocks 2/3	Lab Final Exam
7 April	Overflow and Review	

University Policies and Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

Recognition of Mi'kmaq Territory Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit or e-mail the Indigenous Student Centre at 1321 Edward St or elders@dal.ca. Additional information regarding the Indigenous Student Centre can be found at: https://www.dal.ca/campus_life/communities/indigenous.html

Internationalization At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: <https://www.dal.ca/about-dal/internationalization.html>

Academic Integrity At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. Additional academic integrity information can be found at: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre (https://www.dal.ca/campus_life/academic-support/accessibility.html) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of

Agriculture, please contact the Student Success Centre in Truro (<https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html>)

Conduct in the Classroom – Culture of Respect Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

Diversity and Inclusion – Culture of Respect Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: <http://www.dal.ca/cultureofrespect.html>

Student Code of Conduct Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner - perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. The full Code of Student Conduct can be found at: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Fair Dealing Policy The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html

Originality Checking Software The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at: https://www.dal.ca/dept/university_secretariat/policies/academic/student-submission-of-assignments-and-use-of-originality-checking-software-policy-.html

Student Use of Course Materials Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.

STUDENT RESOURCES AND SUPPORT

University Policies and Programs

Classroom Recording Protocol:

https://www.dal.ca/dept/university_secretariat/policies/academic/classroom-recording-protocol.html

Dalhousie Grading Practices Policies:

https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Grade Appeal Process: https://www.dal.ca/campus_life/academic-support/grades-and-student-records/appealing-a-grade.html

Sexualized Violence Policy: https://www.dal.ca/dept/university_secretariat/policies/health-and-safety/sexualized-violence-policy.html

Scent-Free Program: <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>

Learning and Support Resources

General Academic Support – Advising (Halifax): https://www.dal.ca/campus_life/academic-support/advising.html

General Academic Support – Advising (Truro): <https://www.dal.ca/about-dal/agricultural-campus/ssc/academic-support/advising.html>

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness.html

On Track (helps you transition into university, and supports you through your first year at Dalhousie and beyond): https://www.dal.ca/campus_life/academic-support/On-track.html

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Indigenous Connection: <https://www.dal.ca/about-dal/indigenous-connection.html>

Elders-in-Residence (The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit the office in the Indigenous Student Centre or contact the program at elders@dal.ca or 902-494-6803:

<https://cdn.dal.ca/content/dam/dalhousie/pdf/academics/UG/indigenous-studies/Elder-Protocol-July2018.pdf>

Black Student Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre.html

South House Sexual and Gender Resource Centre: <https://southhousehalifax.ca/about/>

LGBTQ2SIA+ Collaborative: <https://www.dal.ca/dept/vpei/edia/education/community-specific-spaces/LGBTQ2SIA-collaborative.html>

Dalhousie Libraries: <http://libraries.dal.ca/>

Copyright Office: <https://libraries.dal.ca/services/copyright-office.html>

Dalhousie Student Advocacy Services: <https://www.dsu.ca/dsas?rq=student%20advocacy>

Dalhousie Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Human Rights and Equity Services: <https://www.dal.ca/dept/hres.html>

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Study Skills/Tutoring: http://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Faculty of Science Advising Support: <https://www.dal.ca/faculty/science/current-students/undergrad-students/degree-planning.html>