

ERTH 3207 Metamorphic Petrology and Processes - Syllabus

Course description

ERTH 3207 Metamorphic Petrology and Processes [0.5 credit]

Genesis of metamorphic rocks as determined from field, petrographic and geochemical data.

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

Precludes additional credit for ERTH 3202 (no longer offered).

Prerequisite: ERTH 2104.

Learning outcomes

1. Introduce the important methods of a metamorphic geologist.
2. Introduce known facts and recent hypotheses about the evolution of metamorphic rocks.
3. Introduce some of the important analytical methods used in modern metamorphic petrology.
4. Learn how metamorphic rocks are classified and named.
5. Identify common metamorphic minerals and rocks in hand specimen and thin section.
6. Reinforce some of the key thermodynamic variables and their relevance to metamorphic petrology.
7. Learn how to use metamorphic petrology to better understand the past tectonic behaviour of Earth's crust.

Times and locations

This course combines in-person and online delivery types, subject to government regulations and public health guidelines. All lectures will be held online each Thursday from 9:35 - 11:25, and the lab sections will be held Fridays from 11:35 - 14:25. Some lab sessions will be conducted online and others will be conducted in-person (Herzberg Labs, room 2120). Please see the Course Plan for details. Online sessions will be conducted synchronously using the Zoom video conferencing platform. Zoom invitations will be sent out by the teaching team prior to each session. Students cannot attend a different lab time/day/section but must attend the section that they have registered in. All students must follow lab protocols. For details, please see here: https://earthsci.carleton.ca/sites/default/files/content-files/TeachingLabs_EarthSci_COVID19_Guidelines%5B1%5D.pdf

Please also review the return to campus lab video here: <https://earthsci.carleton.ca/return-to-campus-2021>

Teaching team

Instructor: Fred Gaidies

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Teaching assistant: Thereza Yogi

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Textbooks

Yardley, B., Warren, C., 2021. *An introduction to metamorphic petrology*. Cambridge. This is a good introduction to metamorphic petrology. This textbook is **recommended** for the course.

Best, M. G., 2003. *Igneous and metamorphic petrology*. Blackwell. This very good introductory book to both igneous and metamorphic petrology is **recommended** for the course.

Nesse WD (2012) *Introduction to Optical Mineralogy*. Oxford University Press. This is an excellent text on the optical properties of minerals, and you will be needing it in all your labs. Therefore, this text is **required** for this course.

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.

The course website contains most of the laboratory assignments, and you will have to read them carefully before the respective labs and lectures. Lecture notes will be made available after each lecture.

Course requirements

It is recommended that students attend all lectures and laboratories. Arriving late to class is distracting to students, professor, and teaching assistants. Students are required to download, install, and use the Zoom videoconferencing software. Instructions can be found here: <https://carleton.ca/zoom/>.

Students are encouraged to complete and hand in all their lab assignments (8) for feedback and consultation. However, only six comprehensive labs (Labs 2-7) must be completed and handed in at the end of the time allotted (1-2 weeks depending on lab). These six labs will be part of the final grade (see below).

Both, the lab component of the course and the final exam must be passed in order to pass the course.

There will be two exams during the course: (1) A two-hour lab exam, and (2) a final exam during the official examination period (to be scheduled by the registrar, 3 hours) that will primarily focus on lecture material.

Grading

07% Lab 2

12% Lab 3

07% Lab 4

07% Lab 5

07% Lab 6

10% Lab 7

25% Lab exam

25% Final exam

Academic Integrity

It is your responsibility to review Carleton's policy on Academic Integrity - Section 10.1 of the Calendar: <https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/academic-integrity-and-offenses-of-conduct/#academic-integrity-policy>

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. Plagiarism and cheating are viewed as being particularly serious and the sanctions imposed are accordingly severe. 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 and cheating – presenting another's ideas, arguments, words or images as your own, using unauthorized material, misrepresentation, fabricating or misrepresenting research data, unauthorized co-operation or collaboration or completing work for another student – weaken the quality of the graduate degree. Academic dishonesty in any form will not be tolerated. Students who infringe the Policy may be subject to one of several penalties including: expulsion; suspension from all studies at Carleton; suspension from full-time studies; a refusal of permission to continue or to register in a specific degree program; academic probation; or a grade of Failure in the course.

Academic Accommodations

You may need special arrangements to meet your academic obligations during the term. For an accommodation request, the necessary processes are described here: <https://students.carleton.ca/course-outline/>

Recording of Class Sessions

This class or portions of this class will be recorded by the instructor for educational purposes. These recordings will be shared only with students enrolled in the course. Your instructor will communicate how you can access the recordings.

Unauthorized student recording of classroom or other academic activities (including advising sessions or office hours) is prohibited. Unauthorized recording is unethical and may also be a violation of University policy. Students requesting the use of assistive technology as an accommodation should contact the [Paul Menton Centre](#). Unauthorized use of classroom recordings – including distributing or posting them – is also prohibited. Under the University's [Copyright Policy](#), faculty own the copyright to instructional materials – including those resources created specifically for the purposes of instruction, such as lectures slides, lecture notes, and presentations. Students cannot copy, reproduce, display, or distribute these materials or otherwise circulate these materials without the instructor's written permission. Students who engage in unauthorized recording, unauthorized use of a recording, or unauthorized distribution of instructional materials will be referred to the appropriate University office for follow-up.

Special Information for Pandemic Measures

All members of the Carleton community are required to follow COVID-19 prevention measures and all mandatory public health requirements (e.g., wearing a mask, physical distancing, hand hygiene, respiratory and cough etiquette) and [mandatory self-screening](#) prior to coming to campus daily.

If you feel ill or exhibit COVID-19 symptoms while on campus or in class, please leave campus immediately, self-isolate, and complete the mandatory [symptom reporting tool](#). For purposes of contact tracing, attendance will be taken in all classes and labs. Participants can check in using

posted QR codes through the cuScreen platform where provided. Students who do not have a smartphone will be required to complete a paper process as indicated on the [COVID-19 website](#).

All members of the Carleton community are required to follow guidelines regarding safe movement and seating on campus (e.g., directional arrows, designated entrances and exits, designated seats that maintain physical distancing). In order to avoid congestion, allow all previous occupants to fully vacate a classroom before entering. No food or drinks are permitted in any classrooms or labs.

For the most recent information about Carleton's COVID-19 response and required measures, please see the [University's COVID-19 webpage](#) and review the [Frequently Asked Questions \(FAQs\)](#). Should you have additional questions after reviewing, please contact covidinfo@carleton.ca

Please note that failure to comply with University policies and mandatory public health requirements, and endangering the safety of others are considered misconduct under the [Student Rights and Responsibilities Policy](#). Failure to comply with Carleton's COVID-19 procedures may lead to supplementary action involving Campus Safety and/or Student Affairs.

ERTH 3207 Metamorphic Petrology - Course Plan

Note that this schedule may be changed during the term.

Week/Date	Thursday lecture	Friday lab
2 Sep 13 - Sep 17	<p>Part I: Administrative stuff</p> <p>Part II: Definition of metamorphism, driving forces, conditions, and processes of metamorphism. Thermal structure of Earth. Terminology of metamorphic rocks.</p> <p>Part III: Metamorphic mineral reactions I: Phases, components, systems, and the Gibbs phase rule; chemical equilibrium and Gibbs free energy; petrogenetic grids.</p>	<p>Lab 1: Mineral recognition: Preparation of a metamorphic minerals atlas (online).</p>
3 Sep 20 - Sep 24	<p>Part I: Metamorphic mineral reactions II: Gibbs free energy of pure and solution phases, and phase assemblages; discontinuous, continuous, and cation-exchange reactions</p> <p>Part II: Metamorphism of pelites I: Metapelitic minerals and the AFM projection.</p>	<p>Lab 2: Metamorphic textures and microstructures (online).</p>
4 Sep 27 - Oct 01	<p>Metamorphism of pelites II: Metamorphic facies; metamorphism at moderate P-T; Barrovian zones; isograds; P-T paths; metamorphic field gradients; prograde and retrograde metamorphism; contact metamorphism.</p>	<p>Lab 3: Metapelites in hand sample and thin section: Metamorphism of the Fernleigh Belt (Central Metasedimentary Belt, Grenville Province, Ontario) (in-person).</p>
5 Oct 04 - Oct 08	<p>Metamorphism of pelites III: Petrography of metapelites</p>	<p>Lab 3 (cont.) (in-person).</p>
6 Oct 11 - Oct 15	<p>Part I: Analytical methods in metamorphic petrology: Electron probe micro-analysis (EPMA).</p> <p>Part II: Introduction to geothermobarometry.</p>	<p>Lab 4: Application of the electron probe micro-analyzer in metamorphic petrology, and estimation of metamorphic temperatures through conventional geothermometry (online).</p>
7 Oct 18 - Oct 22	<p>Metamorphism of intermediate to mafic rocks: Minerals of metabasites and their graphical representation; metabasite minerals of the greenschist, epidote-amphibolite, amphibolite, and granulite facies; mineral assemblages and reactions at moderate P-T, and comparison with metamorphism of pelites; metamorphism of mafic rocks at high and low pressure.</p>	<p>Lab 5: Metabasites in hand sample and thin section: Metamorphism at moderate pressures (in-person).</p>

Week/Date	Thursday lecture	Friday lab
8 Oct 25 - Oct 29	Reading Week	
9 Nov 01 - Nov 05	<p>Part I: A cautionary tale. Part II: The petrography of metabasites, granulites, blueschists, eclogites.</p>	Lab 6: Granulites, blueschists, and eclogites in hand sample and thin section (in-person).
10 Nov 08 - Nov 12	<p>Part I: Marbles and calc-silicates. Part II: Schreinemakers' bundles.</p>	Lab 7: Calc-silicate rocks in hand samples and thin sections (online).
11 Nov 15 - Nov 19	A case study.	Lab 7 (cont.) (online).
12 Nov 22 - Nov 26	<p>Part I: Metamorphism of ultra-mafic rocks. Part II: Metamorphism of rocks with unusual bulk composition. Part III: Zoned metamorphic minerals.</p>	Lab 8: Metamorphism of ultramafic and altered volcanic rocks (in-person).
13 Nov 29 - Dec 03	<p>Part I: Review of Lab 7. Part II: Petrogenetic grids and rock-specific phase diagrams.</p>	Lab review (in-person).
14 Dec 06 - Dec 10	<p>Part I: Review of metamorphic mineral reactions. Part II: Review of class.</p>	Lab Exam (in-person).
Official Examination Period		