

## EARTHSCI 3316A 001: Igneous and Metamorphic Petrology

### 1. COURSE INFORMATION

EARTH SCIENCES 3313A IGNEOUS AND METAMORPHIC PETROLOGY (Fall 2025)

#### Recommended Prerequisites

##### *Antirequisite(s):*

Earth Sciences 3313A/B Igneous Petrology

Earth Sciences 3315A/B Metamorphic Petrology

##### *Pre-or Corequisite(s):*

Earth Sciences 2206A/B Mineral Systems, Crystallography, and Optics

Earth Sciences 2230A/B Introduction to Geochemistry

***Introductory knowledge of mineralogy and geochemistry are highly recommended for this course, but individuals may enroll if they have written special permission from the Department of Earth Science and the approval of the instructor. Enrollment without the recommended prerequisite or written approval will result in removal/withdrawal from this course in accordance with university policy. This may be done after the add/drop deadline of the academic term, and the course will be marked as withdrawn (WDN) on your academic record. This decision may not be appealed.***

For more information, please contact the Department of Earth Science undergraduate coordinator, Dr. Cam Tsujita ([ctsujita@uwo.ca](mailto:ctsujita@uwo.ca)), or your departmental dean.

#### **Delivery**

Lecture: In-person and remote; M/W 1:30-2:30 pm EST

Lab: In-person; W 2:30-5:30 pm EST

#### **Important dates**

Sept. 4	Classes begin (Thursday)
Sept. 8	<b>First Lecture for 3316A (Remote/Prerecorded)</b>
Sept. 12	Last day to add a Fall/Winter 24-week course or a Fall 12-week course.
Sept. 17	<b>First Lab for 3316A</b>
Sept. 30	National Day for Truth and Reconciliation (observed at Western). No classes.
Oct. 13	Thanksgiving (No classes)
Oct. 22	<b>MIDTERM EXAM for 3316A</b>
Nov. 3-9	Fall Reading Week (Monday to the following Sunday)
Dec. 1	Last day to withdraw from a Fall 12-week course without academic penalty
Dec. 9	Last day of classes in the Fall term
Dec. 10	Study Day
Dec. 11–22	December examination period ( <b>Date for the final for 3316A TBD</b> )

### 2. INSTRUCTOR INFORMATION

Instructors	Email	Office	Office Hours
Dr. Wyatt Bain	<a href="mailto:wbain2@uwo.ca">wbain2@uwo.ca</a>	BGS 1070	M 3:00-5:00 pm EST
TA: TBD			

Students must use their Western (@uwo.ca) email addresses when contacting their instructors. Emails will be answered within 24 hours, Monday to Friday. Emails received over the weekend will be answered the following Monday.

### ***Office Hours***

In-person or via Teams, Monday afternoons from 3:00 to 5:00 pm EST. Anyone needing my help outside those times must email the instructor to arrange a meeting time.

## **3. COURSE DESCRIPTION**

### ***Igneous and Metamorphic Petrology***

This course introduces the following topics:

- 1) The mineralogy, texture, and structure of igneous and metamorphic rocks.
- 2) Igneous and metamorphic processes.
- 3) The factors that control the chemical and textural evolution of igneous and metamorphic rocks (e.g. temperature, pressure, composition, fluid activity).
- 4) Relationships between rock types and plate tectonic settings.
- 5) The use of phase equilibria and geochronology to understand geologic events.
- 6) Igneous and metamorphic rocks in hand sample and thin section descriptions.

### ***Why Study Igneous and Metamorphic Petrology?:***

Igneous and metamorphic rocks are two of the three (maybe four?) fundamental geologic materials that comprise the Earth's crust and drive the formation and evolution of the oceans and atmosphere. Igneous and metamorphic petrology (both fundamental and applied) encompasses the study of these rocks. It is essential for understanding geologic time, the heterogeneous structure of the Earth, and how terrestrial bodies work as natural systems. Consequently, anyone working in any facet of geoscience must have a strong fundamental understanding of this topic and be able to apply it in a field and laboratory setting.

### ***Key learning outcomes:***

Upon successful completion of this course, students will be able to:

- Observe and identify diagnostic minerals and textural features of igneous and metamorphic rocks in thin section and hand specimen.
- Describe and classify intrusive and extrusive igneous rocks using geochemical, textural, and contextual characteristics.
- Describe and classify metamorphic rocks and recognize protoliths using geochemical, textural, and contextual characteristics.
- Use phase diagrams and the textures, geochemistry, and petrography of igneous and metamorphic rocks to understand and interpret magmatic and metamorphic processes.
- Understand the relationship between igneous and metamorphic rocks and how this relationship is expressed in the structural and compositional evolution of the Earth.

#### 4. SCHEDULE

Igneous and metamorphic petrology are typically taught as two separate classes due to the enormous breadth of both topics. This is also a brand-new course! As a result, the schedule shown here is condensed and tentative, and may change over the semester as we dial in the course content.

	Monday	Wednesday	Lab
Week 1: 8/10-Sept	Lec 0: Introduction, The Big 10, and 5 Diagrams (Remote or prerecorded; TBD)	Ig 1: Earth structure, key evidence, mineralogic classification of igneous rocks (Chapters 1-2)	Lab Ig 1: Microscope familiarization, mineralogy, and Textures (Due 24-Sept)
Week 2: 15/17-Sept	Ig 2: Igneous textures and structures Quiz 1 (Chapters 3-4)	Ig 3: Chemical petrology 1 (Chapters 8, +/-9)	No lab
Week 3: 22/24-Sept	Ig 4: Thermodynamics, 1- and 2-component systems, and how to melt a rock Quiz 2 (Chapters 5-6)	Ig 5: >2-component systems, P-T considerations, and more on how to melt a rock (Chapter 7)	Lab Ig 2: Volcanic rocks (Due 1-Oct)
Week 4: 29-Sept/1-Oct	Ig 6: How to make a mafic rock and chemical petrology 2 Quiz 3 (Chapters 9, 10)	Ig 7: How to make a felsic rock and more chemical petrology (Chapter 9, 11)	Lab Ig 3: Mafic intrusive rocks (Due 8-Oct)
Week 5: 6/8-Oct	Ig 8: Igneous environments→Layered intrusions, MORBs, OIBs, and Flood Basalts Quiz 4 (Chapters 12-15)	Ig 9: Igneous environments→Subduction, arcs, and granitoids (Chapter 16-18)	Lab Ig 4: Felsic intrusive rocks (Due 15-Oct)
Week 6: 15-Oct	Happy Thanksgiving	Ig 10: Igneous environments→EARS, alkaline magmas, and other strange rocks (Chapter 19-20)	Lab Ig 5: Alkaline and hydrothermal rock (Due 29-Oct)
Week 7: 20/22-Oct	Ig Review (Remote or prerecorded; TBD)	MIDTERM EXAM	No lab
Week 8: 27/29-Oct	Met 1: Introduction to metamorphism Quiz 5 (Chapter 21)	Met 2: Classification of metamorphic rocks (Chapter 22)	Lab Met 1: TBD (Due 12-Nov)
Week 9: 10/12-Nov	Met 3: Structures and textures of metamorphic rocks Quiz 6 (Chapter 23)	Met 4: Equilibrium and metamorphic mineral assemblages (Chapter 24)	Lab Met 2: TBD (Due 19-Nov)
Week 10: 17/19-Nov	Met 5: Metamorphic facies and reactions	Met 6: Metamorphic reactions continued	Lab Met 3: TBD (Due 26-Nov)

	Quiz 7 (Chapter 25, 26)	(Chapter 26)	
Week 11: 24/26-Nov	Met 7: Thermodynamic topics and metamorphic rocks Quiz 8 (Chapter 27)	Met 8: Metamorphic environments→ Mafic rocks and greenstones (Chapter 25)	Lab Met 4: TBD (Due 3-Dec)
Week 12: 1/3-Dec	Met 9: Metamorphic environments→ Pelitic sediments and carbonates Quiz 9 (Chapter 27, 29)	Met 10: Fluids, mass transport, and \$\$\$ (Chapter 30)	Lab Met 5: TBD (Due 10-Dec)
Week 13: 8/10-Dec	Met review Quiz 10	No Class	Lab final

### Laboratories

- The first lab is on September 17th. **You need to bring \$20 cash for a deposit on a microscope key**, which will be returned at the end of the semester.
- The labs will be formatted like real-life projects and will be report-based.
- **You will have one week to complete each lab** (e.g. the Lab assigned on 17-Sept will be due on 24-Sept)
- The labs are scheduled for 3 hours, but are structured like take-home assignments. **You should expect to put in some time on these.** You do not need to stay for the whole time, but **be aware that the scheduled lab time is the only time the instructor is guaranteed to be present to help with the laboratory exercises.**
- The metamorphic labs topic will be announced later in the term.
- The lab final will be cumulative.
- **An optical mineralogy text is strongly recommended for the lab.** Suggested books include:
  - Nesse (2003) Introduction to Optical Mineralogy.
  - Deer, Howie and Zussman, (1992) An Introduction to Rock-Forming Minerals.
  - Philpotts (1989) Petrography of igneous and metamorphic rocks.
- **Other Required Lab Materials: 10x or better hand lens, a pencil, and a magnet**

### 4. Course Materials

**There is no required text for this course**, but be aware that the course is based on the text *An Introduction to Igneous and Metamorphic Petrology* (2001), by John Winters. This text and the 2nd edition (*Igneous and Metamorphic Petrology*, 2010) have since been discontinued. This is good news for us because you can now find free PDFs online, easily check out copies from the library, and buy used copies for a low price (Recommended). New copies are also available through the campus bookstore. The author has also provided his course slides on his webpage <https://www.whitman.edu/geology/winter/> Just look under “Petrology” and “Text Support”. It is highly recommended that you review these materials.

Materials from other sources will also be included in lectures and discussed in class. All lectures will be uploaded to the OWL website.

There are several other excellent textbooks on Volcanology, Igneous Petrology and related subjects in the library. These include:

Philpotts, A.R. (2009), Principles of Igneous and Metamorphic Petrology,

Best, M.G., and Christiansen, E.H. (2001) Igneous Petrology

Frost, B.R and Frost, C.D. (2014) Essentials of igneous and metamorphic petrology

Rollinson, H. (1993) Using Geochemical Data: Evaluation, Presentation, Interpretation

All course material will be posted to OWL: <https://westernu.brightspace.com/>

Students are responsible for checking the course OWL site (<https://westernu.brightspace.com/>) regularly for news and updates. This is the primary method by which information will be disseminated to all students in the class.

If students need assistance with the course OWL site, they can seek support on the [OWL Brightspace Help](#) page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

## **5. Methods of Evaluation**

### ***Grading Scheme***

#### **Quizzes 10%**

There will be 10 quizzes starting 15-Sept. The quizzes, which will be at the start of class on Monday each week, will consist of 1-3 questions and cover a topic from the previous week.

#### **Laboratory 20%**

Students are responsible for the material in all of the laboratories for the Laboratory Exam. Each lab will be posted on OWL, and you are responsible for reading the lab handouts prior to the lab session on Thursday.

#### **Mid-Term 20%**

The Mid-Term is on Wednesday, October 22<sup>nd</sup> and will cover the igneous portion of the class. The exam will tentatively consist of two parts: 1) a written in-class portion with some long-answer questions and problem sets; and 2) a take-home portion where you can refine your responses to the in-class portion. Only a writing implement and paper are allowed for part 1. Part 2 is open book, open notes, and students are encouraged to use their notes and any other resources to refine their answers.

#### **Laboratory Exam 20%**

Wednesday, December 10th, during the scheduled lab time. The exam is open book for a mineralogical textbook, and/or a 1-page (double-sided) notes on mineral identification. Previous lab assignments are not permitted. Electronic devices, e.g., cell phones and laptops, are not permitted.

#### **Final Exam 30%**

Date and location to be announced, and will be the same format as the mid-term. It is not cumulative and will focus on the metamorphic part of the class.

## 6. Missed Course Work

### *General information about missed coursework*

Students must familiarize themselves with the *University Policy on Academic Consideration – Undergraduate Students in First Entry Programs*, posted on the Academic Calendar:

[https://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/academic\\_consideration\\_Sep24.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration_Sep24.pdf),

This policy does not apply to requests for Academic Consideration submitted for **attempted or completed work**, whether online or in person. The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult [Accessible Education](#).

For procedures on how to submit Academic Consideration requests, please see the information posted on the Office of the Registrar's webpage:

[https://registrar.uwo.ca/academics/academic\\_considerations/](https://registrar.uwo.ca/academics/academic_considerations/)

All requests for Academic Consideration must be made within 48 hours after the assessment date or submission deadline.

All Academic Consideration requests must include supporting documentation; however, recognizing that formal documentation may not be available in some extenuating circumstances, the policy allows students to make one Academic Consideration request **without supporting documentation** in this course. However, the following assessments are excluded from this and therefore always require formal supporting documentation:

- Examinations scheduled during official examination periods (Defined by policy)
- Practical laboratory tests (Defined by policy)
- Midterms (Designated by the instructor as the one assessment that always requires documentation when requesting Academic Consideration)

When a student mistakenly submits their one allowed Academic Consideration request **without supporting documentation** for the assessments listed above or those in the **Coursework with Assessment Flexibility** section below, the request cannot be recalled and reapplied. This privilege is forfeited.

### *Midterm Examinations*

If you miss the midterm exam, please submit a formal request for academic consideration via the student absence portal. A student granted a consideration will be allowed to take a make-up midterm. A formal request must be made and documented in the student absence portal for this to occur. There is no flexibility on this.

### *Final Examinations*

If you miss the Final Exam, please contact the Academic Counselling office of your Faculty of Registration as soon as you are able to do so. They will assess your eligibility to write the Special Examination (the name given by the University to a makeup Final Exam). There is no flexibility on this.

You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation" (e.g., more than 2 exams in 23-hour period, more than 3 exams in a 47-hour period).

When a student misses the Final Exam for an acceptable reason (e.g. illness, bereavement, etc.) and their Academic Consideration has been granted, they will be allowed to write the Special Examination (the name given by the University to a makeup Final Exam). See the Academic Calendar for details (under [Special Examinations](#)), especially for those who miss multiple final exams within one examination period.

If a student fails to write a scheduled Special Examination, the date of the next Special Examination (if granted) usually will be the scheduled date for the final exam the next time this course is offered. The maximum course load for that term will be reduced by the credit of the course(s) for which the final examination has been deferred. See the Academic Calendar for details (under Special Examinations).

## ***Quizzes***

This course has 10 quizzes, and the 8 quizzes with the highest marks are counted towards your final grade. Should extenuating circumstances arise, students do not need to request Academic Consideration for the first 2 missed quizzes. Academic consideration requests will be denied for the first 2 missed quizzes. Academic Consideration requests may be granted when students miss more than 2 quizzes, and these additional (3<sup>rd</sup>, 4<sup>th</sup>...) missed quizzes will be reweighted to the final exam.

## ***Lab Assignments***

Students are expected to submit each of the assignments by the deadline listed. Should extenuating circumstances arise, please speak to the instructor about the situation. In this case, students do not need to request Academic Consideration and will be granted up to 48 hours to complete the assignment without a late penalty. **This is only if the student immediately contacts the instructor to explain the situation.** If no notice is given or the 48-hour extension is missed, a late penalty of 25% per weekday will be applied. Academic Consideration requests may be granted only for extenuating circumstances that started before the deadline and lasted longer than the No-Late-Penalty Period (48 hours).

## **7. Additional Policies**

### ***Religious Accommodation***

When conflicts arise with a religious holiday that requires an absence from the University or prohibits certain activities, students should request an accommodation for their absence in writing to the course instructor and/or the Academic Advising office of their Faculty of Registration. This notice should be made as early as possible, but not later than two weeks prior to the writing of the examination (or one week prior to the writing of the test).

Please visit the Diversity Calendars posted on our university's EDID website for the recognized religious holidays - <https://www.edi.uwo.ca>

### ***Academic Accommodation Policies***

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

[https://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/Academic Accommodation\\_disabilities.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Accommodation_disabilities.pdf).

### ***General Academic Policies***

The website for Registrar Services is <https://www.registrar.uwo.ca/>.

### ***Use of @uwo.ca email***

In accordance with policy, [https://www.uwo.ca/univsec/pdf/policies\\_procedures/section1/mapp113.pdf](https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf), the centrally administered e-mail account provided to students will be considered the individual's official university email address. It is the responsibility of the account holder to ensure that emails received from the University at their official university address are attended to in a timely manner.

### ***Requests for Relief*** (formally known as "appeals")

Policy on Request for Relief from Academic Decision:

[https://uwo.ca/univsec/pdf/academic\\_policies/appeals/requests\\_for\\_relief\\_from\\_academic\\_decisions.pdf](https://uwo.ca/univsec/pdf/academic_policies/appeals/requests_for_relief_from_academic_decisions.pdf)

Procedures on Request for Relief from Academic Decision (Undergraduate):

[https://uwo.ca/univsec/pdf/academic\\_policies/appeals/undergrad\\_requests\\_for\\_relief\\_procedure.pdf](https://uwo.ca/univsec/pdf/academic_policies/appeals/undergrad_requests_for_relief_procedure.pdf)

Procedures on Request for Relief from Academic Decision (Graduate):

[https://uwo.ca/univsec/pdf/academic\\_policies/appeals/graduate\\_requests\\_for\\_relief\\_procedure.pdf](https://uwo.ca/univsec/pdf/academic_policies/appeals/graduate_requests_for_relief_procedure.pdf)

## ***Scholastic Offences***

Policy on Scholastic Offences:

[https://uwo.ca/univsec/pdf/academic\\_policies/appeals/scholastic\\_offences.pdf](https://uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_offences.pdf)

Procedures on Scholastic Offences (Undergraduate):

[https://uwo.ca/univsec/pdf/academic\\_policies/appeals/undergrad\\_scholastic\\_offence\\_procedure.pdf](https://uwo.ca/univsec/pdf/academic_policies/appeals/undergrad_scholastic_offence_procedure.pdf)

Procedures on Scholastic Offences (Graduate):

[https://uwo.ca/univsec/pdf/academic\\_policies/appeals/graduate\\_scholastic\\_offence\\_procedure.pdf](https://uwo.ca/univsec/pdf/academic_policies/appeals/graduate_scholastic_offence_procedure.pdf)

## ***Use of Electronic Devices During Assessments***

In courses offered by the Faculty of Science, the possession of unauthorized electronic devices during any in-person assessment (such as tests, midterms, and final examinations) is strictly prohibited. This includes, but is not limited to: mobile phones, smart watches, smart glasses, and wireless earbuds or headphones.

Unless explicitly stated otherwise in advance by the instructor, the presence of any such device at your desk, on your person, or within reach during an assessment will be treated as a *scholastic offence*, even if the device is not in use.

Only devices expressly permitted by the instructor (e.g., non-programmable calculators) may be brought into the assessment room. It is your responsibility to review and comply with these expectations.

## ***Use of Generative AI Tools***

Generative AI tools (e.g., ChatGPT, Copilot, Gemini) are strictly **prohibited on any graded item in this course, including assignments, tests, or quizzes**. Using such tools for content generation, code writing, problem solving, translation, or summarization—when not explicitly allowed—will be treated as a **scholastic offence**. Anyone found using generative AI tools on graded items will receive a zero (0). However, editorial tools that use AI (e.g. Grammarly) are acceptable, but you should not use generative features. It is your responsibility to seek clarification before using any AI tools in academic work. Be aware that graded items have been designed to limit the usefulness of AI tools, and all graded items in this course may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism.

## ***Support Services***

Please visit the Science & Basic Medical Sciences Academic Advising webpage for information on adding/dropping courses, academic considerations for absences, requests for relief, exam conflicts, and many other academic-related matters: <https://www.uwo.ca/sci/counselling/>.

Students who are in emotional/mental distress should refer to Mental Health@Western (<https://uwo.ca/health/>) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence (GBSV) and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced GBSV (either recently or in the past), you will find information about support services for survivors, including emergency contacts at:

[https://www.uwo.ca/health/student\\_support/survivor\\_support/get-help.html](https://www.uwo.ca/health/student_support/survivor_support/get-help.html).

To connect with a case manager or set up an appointment, please contact [support@uwo.ca](mailto:support@uwo.ca).

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. If you have any questions regarding accommodations, you may also wish to contact Accessible Education at

[http://academicsupport.uwo.ca/accessible\\_education/index.html](http://academicsupport.uwo.ca/accessible_education/index.html)

Learning-skills counsellors at Learning Development and Success (<https://learning.uwo.ca>) are ready to help you improve your learning skills. They offer presentations on strategies for improving time



management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Additional student-run support services are offered by the USC, <https://westernusc.ca/services/>.