Western Science

Department of Earth Science

Earth Sciences 3371A: Metallogeny II: Ore Deposits Models

1. COURSE INFORMATION

EARTH SCIENCES 3371A: METALLOGENY II ORE DEPOSIT MODELS (Fall 2025)

Recommended Prerequisites

Earth Sciences 2206A/B Mineral Systems, Crystallography, and Optics
Earth Sciences 3316A: Igneous and Metamorphic Petrology

Introductory knowledge of mineralogy, petrology, and geochemistry is highly recommended for this course*, but individuals may enroll with written special permission from the Department of Earth Science and the instructor's approval. 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 This may be done after the add/drop deadline of the academic term, and the course will be marked as withdrawn (WDN) on your academic record.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), or your departmental dean.

Delivery

BGS 1069

Lecture: BGS 1069; In-person and remote; M/F 8:30-9:30 am EST
Lab: BGS 1069; In-person; M 6:00-9:00 pm EST

Important dates

Jan. 6	Classes begin (Tuesday)
Jan. 12	**First Lecture for 3371A**
Jan. 19	**First Lab for 3371A**
Feb. 15-23	Family Day/Study Week: No classes.
Apr 04.	Classes end
Apr 07-30	Exam period
Apr. 18	Good Friday: No classes
Apr. 20	Easter: No Class

2. INSTRUCTOR INFORMATION

Instructors	Email	Office	Office Hours
Dr. Wyatt Bain	wbain2@uwo.ca	BGS 1070	M 4:00-6:00 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 4:00 to 6:00 pm EST (Tentative). Anyone needing my help outside those times must email the instructor to arrange a meeting time.

3. COURSE DESCRIPTION

Metallogeny II (Ore Deposit Models)

This course introduces the following topics:

1) Introductory igneous petrology, geochemistry, and optical microscopy of sulphides and oxides.
2) The concept of mineral deposits, resources, and reserves.
3) The concept of critical minerals.
4) The *sources-transport-trap* model for ore deposits.
5) The geology, geochemistry, and setting of magmatic, magmatic-hydrothermal, hydrothermal, orogenic, and critical mineral-bearing deposit types.
6) The geology of important Canadian deposit types and the economic considerations surrounding their demand and production potential.
7) Basic exploration and data processing techniques.

Why Study Ore Deposits?:

- Modern civilization depends on the availability of mineral resources.
- Our understanding of the physical, chemical, and genetic processes involved in ore deposit formation underpins our ability to locate, characterize, and quantify mineral resources.
- The processes involved in ore deposit formation are an expression of the larger-scale processes that drive the compositional evolution of the mantle, crust, oceans, and atmosphere.
- Our understanding of ore deposits draws on all the various subdisciplines in Earth science. Thus, the study of ore deposits will help synthesize one's fundamental and applied understanding of Earth Science.
- There is an enormous demand in Canada and abroad for geoscience professionals with ore deposit experience.
- By cultivating an understanding of ore deposit models and exploration, students will gain a well-rounded geoscience skill set and cultivate credentials that can be readily translated into employment and prosperity.
- This course can be used to pursue a P Geo.

Key learning outcomes:

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

- Understand how social, environmental, infrastructure, economic, geologic, and historical factors differentiate an ore deposit from a geochemical anomaly.
- Observe, identify and document oxide and sulphide minerals in hand sample and thin section.
- Observe, identify and document various mineralization styles, alteration types, and the common host rock types for each.
- Describe and classify the geochemical expression of mineralizing processes on the outcrop, deposits, district, and system scales.
- Understand deposit models for common ore deposit types in Canada and how these models are used in mineral exploration and development.
- Understand the concept of critical minerals and the geologic, economic, and geopolitical considerations associated with non-base/precious metal production.
- Prepare research-grade figures.

4. SCHEDULE

- The schedule shown here is tentative and may change over the semester.
- I am open to negotiating the weekly schedule to suit the students' needs.

	Monday	Friday	Lab
Week 1: 09-Jan	No Class	No Class	No Lab
Week 2: 12/16-Jan	OD1: Introduction to metallogeny II (2026) Quiz 1	OD2: Basic geochemistry, petrology, and the 3-10-5	Lab 1: Opaque minerals in thin section and hand sample
Week 3: 19/23-Jan	OD3: Magmatic sulfide deposits 1 Quiz 2	OD4: Magmatic sulfide deposits 2 (**TBD**/**Remote**)	Lab 2: Magmatic deposits and cumulate rocks
Week 4: 26/30-Jan	OD5: No class	OD6: Magmatic-hydrothermal deposits 1 (Porphyry deposits; **Remote**)	No Lab
Week 5: 02/06-Feb	OD7: Magmatic-hydrothermal deposits 1 (Skarn deposits) Quiz 3	OD8: Magmatic-hydrothermal deposits 2 (Epithermal deposits)	Lab 3: Magmatic-hydrothermal deposits (Porphyry deposits)
Week 6: 09/13-Feb	OD9: Magmatic-hydrothermal deposits 3 Quiz 4 (Alkalic porphyries and lode veins)	OD10: LTC Pegmatites	Lab 4: Magmatic-hydrothermal deposits (Skarn/Epithermal)
Week 7: 16/20-Feb	**Reading Week**	**Reading Week**	**Reading Week**
Week 8: 23/27-Feb	OD11: Carbonatites	MIDTERM (OD1-OD10)	No Lab
Week 9: 02/06-Mar	OD12: Hydrothermal deposits 1 (VMS) Quiz 5	OD13: Hydrothermal deposits 2 (VMS)	Lab 5: VMS (Greens Creek)
Week 10: 09/13-Mar	OD13: Ig 4: Hydrothermal deposits 3 (Sedex) Quiz 6	OD14: Hydrothermal deposits 4 (MVT)	Lab 6: MVT
Week 11: 16/20-Mar	OD15: Hydrothermal deposits 5 (Orogenic-Au) Quiz 7	OD16: Hydrothermal deposits 6 (Roll-front and unconformity type U)	Lab 7: Orogenic-Au
Week 12: 23/27-Mar	OD17: BIFs and Pelo placer depsoits (Witts and Eliot Lake) Quiz 8	OD18: Critical minerals 1	Lab 8: Critical Minerals
Week 13: 30-Mar/03-Apr	OD18: Critical minerals 2	Review	Lab final

Laboratories

- May involve bringing $20 cash for a deposit on a microscope key
- 3 hours
- You should expect to put in some time on these.
- Graded portion:
    - Focused on gathering observations and making reasonable interpretations.
    - You will have one week to complete each lab (e.g. the Lab assigned on 12-Jan will be due on 19-Jan)
- Ungraded portion
    - Focused on familiarizing you with the topics covered on the lab final.

Suggested books include:

- **Spry and Gedlinske (1987) Table for the Determination of Common Opaque Minerals**
- 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 *The Geology of Ore Deposits*, by John M. Guilbert and Charles F. Park. This text is still in print and can be purchased directly from the publisher or, for much cheaper, second-hand through online sellers. I highly recommend purchasing this book.

Materials from other sources will also be included in lectures and discussed in class. These materials, along with all lectures, will be posted to the OWL website: 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 8 quizzes starting 12-Jan. 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 30%

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 Friday, February 27th and will cover Lectures DB1-DB10. 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%

Tenatively scheduled for March 30th, 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 20%

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,

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/
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 (3rd, 4th…) 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.

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, 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

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

Scholastic Offences
Policy on Scholastic Offences:
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
Procedures on Scholastic Offences (Graduate):
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.

To connect with a case manager or set up an appointment, please contact 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

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/.