Western Science

Department of Earth Sciences

Geology 9576B Course Outline

1. Course Information

Course Information
Earth Sciences 9576B. Glacial and Quaternary Geology – Winter 2024
Types of glaciers. Glacial dynamics and budgets. Glacial ice movement. Erosional and depositional glacial landforms. Glacial sediments, facies, and environments. Sea-ice, ice shelves, and fjords. Lakes and bogs. Paleosols, wind-blown sediments, and loess deposits. Permafrost. Quaternary timescale and glaciations. Quaternary climate change: short-term and long-term factors. Interpretation of Quaternary environments: Biological evidence. Dating methods. Deep-sea sedimentary record and oxygen isotopes. Ice-core stratigraphy. Climate in the Holocene. Climate-human interactions. Ancient glaciations. Glacial deposits and resources.

Lectures:
Laboratories:

Pre-Requisite: 0.5 course from Earth Sciences 2260A/B, 3314A/B, Geography 2330A/B, 3333A/B, 3334A/B, 3350A/B, the former 3331A/B, 3332A/B, or permission of the Department.

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

2. Instructor Information

Instructor	Email	Office	Phone	Office Hours
Dr. Alina Shchepetkina			TBD	Open door

Students must use their Western (@uwo.ca) email addresses when contacting their instructors.

3. Course Syllabus, Schedule, Delivery Mode

Both lectures and laboratories will be conducted entirely in person.
Lectures:
Laboratories:

Much of the surface of Canada is covered by Quaternary sediments deposited by glaciers. In this course, we will take a holistic look at glaciers. **First**, we will look at how glaciers form, where they are found, and how they grow, shrink, and move. **Secondly**, we will talk about glacial erosional and depositional forms, how we can reconstruct glacial movements, which sub-environments exist within a glacial

system, and which type of deposits are being left by them (i.e., geomorphological and sedimentological evidence). **Thirdly**, we will examine the Quaternary period: its timescale, fossil animal and plant evidence used to reconstruct the Quaternary environments and ecology, dating methods, and associated climate changes. **Finally**, we will broaden the picture by discussing ancient glaciations, human-climate interactions, and practical use of glacial deposits, such as aquifers, sewage reservoirs, sources of construction materials, and mineral exploration in glaciated terranes. During the labs, practical exercises will be undertaken to characterize and interpret glacial materials.

Laboratory sessions: Labs will be marked and are due at the end of the lab period. During the next lab period, the marked labs will be distributed, and the solutions will be discussed. The class members will be asked to contribute to the solution to each problem. All laboratories are required, but if a student has a valid reason for missing a lab, one lab can be missed, and the lab mark will be pro-rated based on the completed labs. Lab material will be uploaded to the OWL website before the lab. Some laboratory sessions will be devoted to the preparation of a paper on a given topic. The paper is to be written following the format of the journal Quaternary Science Reviews. Each paper will be reviewed first by an appointed classmate, and then, by the course instructor. Each student will deliver their findings to the class in a 10 minute presentation, held in lab time.

Learning Outcomes:
Upon successful completion of this course, students should be able to:
1. Identify the main types of glaciers, and how they form, grow, shrink, and move.
2. Relate the main glacial sub-environments and processes to resultant glacial deposits.
3. Have a working knowledge of the Quaternary timescale, glacial-interglacial cycles, and causes of short-term and long-term climate change.
4. Describe the fossil animal and plant evidence currently used to reconstruct Quaternary environments and ecology and name the most applicable Quaternary geochronology methods.
5. Have a basic understanding of past glaciation events and their distribution.
6. Describe the human impact on climate change and glacial landforms.
7. Apply Quaternary Geology to mineral exploration, water, and aggregate resources.

Week	**Main Topics in Lectures** **TUESDAY & THURSDAY**	**Lab Sessions** **FRIDAY**
1	Course introduction. Syllabus. Cryosphere. Snow and ice. Location of glaciers.	
	Classifications of glaciers (geomorphology and thermal regime). Glacial growth, shrinkage, budget. Glacial movement.	Identification of glacier types, environments, and glacial budgets. Use of ArcMap and Google Earth.
2	Glacial erosion and erosional landforms. Indicators of glacial movement	
	Glacial depositional forms. Geomorphology.	Glacial geomorphology.
3	Glacial sediments. Terminology. Glacial facies. Till classification and fabric. Sedimentary structures.	
	Glacial sedimentology. Field and laboratory methods.	Glacial core exercise. 5 pm: You will receive an email with the topic for the term paper and presentation
4	Periglacial environments: Glacio-marine. Sea ice and ice	

	shelves. Fjords. Icebergs. IRD.	
	Periglacial environments: Lakes and bogs. Pluvial lakes. Lake-level change and paleoclimate.	Field and laboratory methods. Till description.
5	Periglacial environments: Wind-blown sediments and loess.	
	Periglacial environments: Permafrost.	Construction of a geological cross-section, lithofacies, glacial history
6	Quaternary timescale. Glacial-interglacial stages and stadials. New developments in Quaternary science.	
	Quaternary climate change: long-term and short-term factors. Milankovitch cycles.	**Mid-term test**
7	**Spring break**	
	Spring break	**Spring break**
8	Interpretation of Quaternary environments and ecology: pollen and spore, diatom, and non-marine molluscan analyses.	
	Interpretation of Quaternary environments and ecology: marine mollusca, foraminifera, radiolaria, coccolithophores, and dinoflagellates. Biomarkers.	Free/library time: Paper preparation.
9	Dating methods: radiocarbon, potassium-argon, argon-argon.	
	Dating methods: Uranium-series, fission track, luminescence, electron spin resonance.	Free/library time: Paper preparation. 5 pm: Email the first draft of the paper to the reviewer (CC the instructor).
10	Dating methods: Cosmogenic radionuclides, dendrochronology, varve chronology, lichen.	5 pm: Reviewers email the edited paper and referee form to the author for edits (CC the instructor).
	Deep-sea and oxygen isotope record. Global correlations.	Revision of the term paper. Preparation of presentation. 5 pm: Email the revised paper to the instructor.
11	Ice-core stratigraphy and dating.	
	Climate in the Holocene. Climate-human interactions.	Glacial conference: Prepare 10-min presentations on your essay topic, 3-5 min for questions.
12	Ancient glaciations. Snowball Earth.	
	Glacial deposits and resource distribution.	Practical uses of glacial deposits.
13	Glacial deposits and resource distribution. Glacial geology of London area	
	Catch-up, Review, or free time, as necessary. Last Class	**Good Friday**
		Final exam: date and place TBD

Contingency plan for an in-person class pivoting to 100% online learning

In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, affected lecture content will be delivered entirely online, via online sessions on Zoom. Pop quizzes will be also conducted via Zoom, if necessary. Lab exercises will be 'take-home' time-limited and submitted electronically. No computer program (e.g. ProctorTrack) will be used to monitor take-home labs. The grading scheme will **not** change. The mid-term and final exams

will be conducted via Zoom **orally.**

4. Course Materials

Text: Lowe, J. and Walker, M., 2015. *Reconstructing Quaternary Environments*. New and second-hand copies are available on Amazon (paperback, hardcover, and Kindle versions). This is an excellent introductory textbook written in simple and clear language. It provides an overview of field and lab techniques for palaeoenvironmental investigation and examines the various forms of evidence used to establish the history and scale of environmental changes during the Quaternary.

Other textbooks: *Past Glacial Environments*, 2nd Edition, edited by John Menzies and Jaap J.M. van der Meer. This book is available for download from the library: https://www-sciencedirect-com.proxy1.lib.uwo.ca/book/9780081005248/past- glacial-environments. This textbook provides many specific case studies and is written by various authors. It is not an easy read and can be rather overwhelming. Recommended as supplementary reading.

All class notices will be posted to OWL 'Announcements' and notes for each lecture will be posted to OWL 'Resources'

Students are responsible for checking the course OWL site (http://owl.uwo.ca) on a regular basis 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 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

The overall course grade will be calculated as listed below:

3 Pop-quizzes	3%
6 lab assignments	18%
1 journal-style term paper	23%
1 term paper review	5%
Glacial conference presentation & active participation	6%
1 Midterm Test (< 3 h)	15%
1 Final Exam (< 3 h)	30%

Pop quizzes – on random dates throughout the course.
Mid-term test, written
Glacial conference
Final Exam: written (unless COVID-19 contingency plan is in place — oral). Date and classroom: TBA.

5a. Journal-style term paper

This is to be written as a journal-style paper. Follow the format of the journal Quaternary Science Reviews (marks will be deducted if this format, including references, is not adhered to).
The guide for authors can be found here: https://www.elsevier.com/journals/quaternary-science-reviews/0277-3791/guide-for-authors.

Term paper topics and at least 5 mandatory references will be emailed to each student by 5 pm on Friday, January 27th. Students are encouraged to procure and cite additional references on the assigned topic.

The essay should consist of a Title, Author Information, Abstract, Keywords, and Introduction, followed by the main body of the text (including figures), Conclusions, and References. The length of the text and figures should not exceed 10 pages (References not included), using a 12 pt. font (Times Roman, Helvetica or Courier), double spacing, and "normal" margins. There should be some figures (with figure captions) illustrating the data and the figures should be properly explained in the text. All material must be properly referenced and the list of references should be included in the journal format.

The marks will be based on the depth of topic understanding, simplicity of the language, logic of arguments, grammar, punctuation, etc. (see rubric below).
The marking rubric for the essay is Title and Author Information (5%), Abstract (10%), Keywords (2%), Introduction (10%), Main Body (40%), Conclusions (10%), References (10%), Overall Writing and Logic (13%).

Format: All papers should have a title page with the title and the author, student, and course numbers. Papers must use Quaternary Science Reviews format, including references. See https://www.elsevier.com/journals/quaternary-science-reviews/0277-3791/guide-for-authors (particularly pages 7–12 of the pdf).
Abstract: Summarizes the main facts and interpretations presented in the essay. It should be comprehensible without reference to the main document. No References should be cited in the Abstract. Less than 200 words.
Introduction: Set the background to the study, identify what the main problem is, why this problem is important, and then outline how you will address this problem in the essay.
Main Body: Think about the order of presentation of data and ideas. If methods need describing (for an essay this normally is not the case), this should come first. Present all of the data first, these are the observations and facts. Then interpret and integrate the data. The interpretation should be consistent with the problem that is identified in the Introduction.
Conclusions: This should summarize the interpretations from the main body of the paper. A minimal amount of data should be repeated here. Conclusions are different from the abstract, the latter summarizes the entire paper, including data, whereas the former only summarizes the interpretations.

The first draft of the paper will be assigned to one of your classmates who will review the paper to check for logic, clarity of expression, and attention to detail. You will then revise the paper according to your referee's suggestions (in Word, Tracking tool ON). The *FINAL* copy of the paper with Tracking ON plus the Referee form will be submitted for marking. The referee will receive credit for doing a careful and helpful review.
* For Tracking in Word: Tab "Review" – "Track changes" – "ON". Please put your name as a user: Word – Preferences – User Information – Name: XXX ("Author" is by default).
TIMELINE: The first draft of the paper is emailed to the reviewer (CC the instructor) by 5 pm, March 17th. The reviewer is to revise and edit the first draft (in Word, use comments and tracking tool!). A referee form will be emailed to the reviewers and has to be filled in. The revised draft and referee form are emailed to the author (CC the instructor) by 5 pm March 22.
The final version of the essay is due at 5 pm, March 24th. 5% per day will be deducted if the paper is handed in late.

6. Student Absences

If you are unable to meet a course requirement due to illness or other serious circumstances, please follow the procedures below.

Assessments worth 10% or more of the overall course grade:
For work totaling 10% or more of the final course grade, you must provide valid medical or supporting documentation to the Academic Counselling Office of your Faculty of Registration as soon as possible. For further information, please consult the University's medical illness policy at

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf.

The Student Medical Certificate is available at

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf.

Students with a valid reason for missing the Mid-Term will be given the opportunity to take a make-up test before the end of the term.

Absences from 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).

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 a 23-h period, more than 3 exams in a 47-h period).

If a student fails to write a scheduled Special Examination, the date of the next Special Examination (if granted) normally 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).

6. Accommodation and Accessibility

Religious Accommodation
When a course requirement conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request accommodation for their absence in writing at least two weeks prior to the holiday to the course instructor and/or the Academic Counselling office of their Faculty of Registration. Please consult University's list of recognized religious holidays (updated annually) at

https://multiculturalcalendar.com/ecal/index.php?s=c-univwo.

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.

7. Academic Policies

The website for Registrarial Services is http://www.registrar.uwo.ca.
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 e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their official university address is attended to in a timely manner.

No electronic devices will be needed, or permitted, for any of the tests in this course.

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.

8. Support Services

Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on adding/dropping courses, academic considerations for absences, appeals, 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 and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (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. You may also wish to contact Accessible Education at

http://academicsupport.uwo.ca/accessible_education/index.html

if you have any questions regarding accommodations.

Learning-skills counselors at the Student Development Centre (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 counseling.

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