Quaternary Sedimentary Environments

Syllabus

Department of Earth and Environmental Sciences

ERTH/GEOG 3302 Fall 2024

Dalhousie University acknowledges that we are in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People and pays respect to the Indigenous knowledges held by the Mi'kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people.

Dalhousie University also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years.

Course Instructor(s)

Name	Email	Office Hours
Dr. John Gosse	John.Gosse@dal.ca	Wed 1:30-2:30 or by appt 4616-Ocean Wing LSC
Lauren MacLellan	Lauren.MacLellan@dal.ca	By appt, Rm 4625

Course Description

The student is exposed to fluvial, alluvial, subglacial, glaciolacustrine, hillslope, eolian, coastal, shallow marine, rift, wedge top, retroarc, and foreland basin environments. Field trips and labs provide experience in methods used to distinguish the environments, including sedimentology, geomorphology, geochronology and thermochronology, and analysis of soils, cores, pebble fabrics, and section-scale non-petroleum sedimentary facies. Quaternary paleoclimatology and tectonic controls on weathering and deposition are discussed and debated. Quantitative assignments will provide experience in interpreting isotopic, geochronologic, paleoclimatic, and sedimentologic data.

Course Prerequisites

ERTH 2203 or similar introductory sedimentology course

Student Resources

Links for important student resources are provided at the end of this syllabus. For field trips we will be using field equipment provided by your fees, including excavation tools to dig soil pits, clear colluvium from important cliff exposures, and safety equipment including helmets and safety vests (see tables of equipment for each field trip). The lectures and laboratory exercises will be held in the new sedimentology and geochemistry lab B-2030.

Course Structure

Course Delivery

This course will be taught in-person, and no synchronous or recorded online sessions are planned. Lectures, field trips, and exams require your attendance. In the case of the impacts of unfavorable weather, field trips may need to be postponed or cancelled, but will be substituted with a different experiential learning exercise. In the case of a pandemic, building closure, or other factors, the lectures, field trips, and experiments can be modified to be accessed online.

Lectures

M, W, F 12:35 to 1:25. Room B-2030. Note that on days where the laboratory will be a field trip, the field trip will start at 12:35.

Laboratories

Field trips: Mon, 12:35 – 5:30, meet in parking lot between the Biology Wing and Kings College at 12:30. Some field trips may run a little longer if traffic is slow. We will do our best to have you back between 5:30 and 6:00 pm on those days.
Experiments: Mon, 1:25 – 5:30, B-2030.

Course Materials

No single available textbook contains the range of topics we cover. However, you will be expected to come to lecture prepared by reading the assigned articles.

For the field trips, there will be a personal gear list provided prior to each trip, but in general bring your notebook, pencil, hand lens, compass, water, boots, rain jacket (check weather). We will provide a printed copy of the field trip or lab assignment during the lab period, and a digital copy before the field trip or exercise, so please skim through the exercise prior to coming.

Assessment

Conversion of numerical grades to final letter grades follows the Dalhousie Grade Scale			
A+ (90-100)	B+ (77-79)	C+ (65-69)	D (50-54)
A (85-89)	B (73-76)	C (60-64)	F (0-49)
A- (80-84)	B- (70-72)	C- (55-59)	

Reading Assignment (15%)

There is no textbook assigned for this class. You are expected to read the assigned readings before the class. I will indicate if you should focus on one particular element of the reading, otherwise you are responsible for reading the entire paper and understanding the figures. While you may not understand everything you read, you are expected to know the general ideas expressed in the papers. If a paper piques your interest, and you want more information beyond what is provided in the cited references list, please send me an email and I'll be happy to give suggestions.

To achieve the full grade for reading, you need to open the Assignment tab in Brightspace, send a text response by 12:35 pm **before** the class with the answer to the questions ending with (Brightspace). Note that not every paper will have assigned questions. Only one late answer will be forgiven for the semester. Check the class *Brightspace* page for uploaded material that I am permitted to share, or download the copyright journal article via one of many methods, e.g.: Scholar Google or http://libraries.dal.ca/

Example, For Friday, Sep 6:

Wysocki, D.A., Schoeneberger, P.J. and LaGarry, H.E., 2000. Geomorphology of soil landscapes. *Handbook of soil science*, *1*, pp. 315-321.

Q1. Referring to Figure 29.9, and thinking of a rural landscape in Nova Scotia, what processes are changing over the next 50 years as a result of climate change, and how and why are they changing? (Brightspace)
Q2. Relate Jenny's Factors to the processes considered by Simonson (1959).
Q3. What factors control how a catena in Nova Scotia will appear?

Mid-Term Test (25%)

The mid-term test, during regular class time, is required and will be a combination of short and long answer questions, designed to be completed in 50 minutes in our usual meeting time and place. It covers all lectures, readings, assignments, and laboratory (field and experiment) exercises prior to the test. **If** a particular assignment or laboratory report has not been graded, the questions on the mid-term regarding that assignment or lab will relate to the scientific question or methodology, and not to your observations.

Final exam (30%)

The final exam will be scheduled by the Registrar's Office for some time during exam week. It likely will be held in the LSC instead of DalPlex. While the 2-hour final exam will emphasize material covered after the mid-term test, the exam is cumulative, and we expect you to be able to use your knowledge of climate and tectonics to interpret sedimentary records.

Field Trips and Experiments (30%)

Field trips or Experiments occur on Monday afternoons. All field trips depart at 12:35 pm on Wednesdays from parking lot between the LSC and Kings College, returning by 6 pm. Writeups will be completed and submitted individually unless otherwise indicated.

Student Equipment and Personal Gear Request for the Field Trips

Date	Boots	Compass	Hand lens	Field notebook	Colored pencils	GPS	Trowel or similar hand tool	Camera	other
Soils	Rec'd (Steel toe and rubber if avail)	Rec'd if available	Req'd	Req'd	Req'd	Rec'd	If available	Rec'd	Fly spray, Sun screen, Water bottle, snack
Glacial	Rec'd	Rec'd if available	Req'd	Req'd	Req'd	Rec'd	If available	Rec'd	Fly spray, Sun screen, Water bottle, snack
Lakes	Req'd: **Steel toe** and rubber if available	Rec'd if available	Req'd	Req'd	Req'd	--	If available	Rec'd	Fly spray, Sun screen, Water bottle, snack

Rec'd = Recommended Req'd = Required

Earth Environmental Science Department Equipment Request for the Field Trips

Date	Helmets	Safety Vest	Small first aid kit	Shovels Long handle	Shovels-D-handle	Picks	Axe	Trowels	Tablet/white board w markers	100' Tape
Soils	no	14	1	8	4	4	1	all	JG has	3
Tills	no	14	1	8	4	4	no	all	JG has	3
Lakes	14	14	1	8	4	4	no	all	JG has	3

Course Policies on Missed or Late Academic Requirements

Missed or late work:

1. The Mid-Term Test and Final Exam are mandatory. Please make every effort to take the test at the time indicated. However, in the case of significant illness or death in the immediate family, I will provide a different makeup test. There are no re-attempts for tests.

2. You shall participate in all labs. If you miss a lab experiment (mostly calculation) owing to significant sickness or death in the immediate family, it is possible to check with the TA to get an extension and you can do the experiment on your own. If you miss a field trip, most of these will not be able to be repeated as permissions are required for access to the sites. We will ignore one missed field trip or experiment (we drop that score or your lowest grade). However, please note that a significant portion of the two tests will be based on knowledge gained during the lab periods and field trips. **Lab writeups are due by the following Monday and will not be accepted if late.**

3. **For readings and assignments, the answers must be submitted by the deadline.** We will drop the lowest score for the readings. No extensions, you can complete all the readings well before the due date, weeks before, if you like.

4. Based on these policies, it is not necessary to use the Student Declaration of Absence for this class.

Course Policies related to Academic Integrity

Generative AI and large language models

In this course, none of the assignments, tests, laboratory reports, or reading questions shall be answered using generative AI or large language models (e.g., ChatGPT).

Collaboration

Sometimes submissions for a lab experiment or fieldtrip will require a group effort. The TA will make clear what elements will be expected to be an individual or group effort. For the reading assignments, while students can discuss the questions with classmates, answers are to be independently written and submitted by the student.

Learning Objectives

This course focuses on the architectural components of sedimentary environments, i.e. larger-scale than the sedimentary-structures you investigated in *Sedimentology*, and overlapping or finer than the elements of facies and large-scale stratigraphy. The emphasis is on developing skills in analysing Quaternary sedimentary records to quantify and interpret surface processes and responses to climate and tectonic changes. A combination of field and theoretical experiments provide experiential opportunities to describe, classify, and analyse glacial, glaciofluvial, glaciomarine, fluvial, lake, coastal, marine, and eolian sediments and records contained within them, to address ongoing questions regarding tectonics and climate controls on sedimentation. Experiments and field trips will include fabric analyses, power spectral analyses, geomorphometry, and geochronology and exposure to regional examples of Quaternary sedimentary environments.

Tentative Schedule for ERTH/GEOG 3302 in 2024F

Lec	Date	Topic	Tentative topic	Reading before the lecture/lab
0	09-04W	Climate, clocks, and the Plio-Pleistocene transition	Course overview and Intro to the Quaternary	
1	09-06F		Regolith, saprolitization, soil development, soil descriptions	*Wysocki et al, 2000*
2	09-09M		***Field Trip: Soils***	***Stea & Gosse, 2004***
3	09-11W		Quaternary paleoclimatology	*Berger et al. 2010*
4	09-13F		Quaternary paleoclimatology	
5	09-16M		Quaternary clocks; ***Expt Radiocarbon and Exposure Dating***	*Hajdas et al., 2021*
6	09-18W		Quaternary clocks	
7	09-20F	Subglacial Environ.	Subglacial environment, recognizing till types and ice sheet dynamics	
8	09-23M		***Field Trip: Sub glacial processes, West Lawrencetown coastal section***	***Staiger et al. 2006 Baffin Island tills***
9	09-25W		Ice sheet models and deglaciation of Atlantic Canada	*Stea and Gosse 2004*
10	09-27F	Sediment delivery to Lakes and oceans	Glacial lake environments and the Younger Dryas Cooling Event	*Ridge et al 2012; Norris et al 2021*
11	~~09-30M~~		National Day for Truth and Reconciliation, No Class	
12	10-02W		Heinrich events, Dansgaard-Oeschger cycles, glaciomarine env	*Schannwell et al. 2024*
13	10-04F		Glaciomarine deltas, and the uplift of Nova Scotia	*Swift and Borns, 1967*
14	10-7M		Deltas and Why are deltas drowning? ***Expt. Paleo-sea-level***	*Syvitski et al., 2009*
15	10-09W		Pelagic and hemipelagic sediments	
16	10-11F	Landscape evolution and sediment flux	Sediment flux, measuring erosion, and Klondike Placer Gold system	
17	~~10-14M~~		Thanksgiving Day, No Class	
18	10-16W		Erosion, uplift, isostasy	*Molnar&England 1990*
19	10-18F		Paleoaltimetry, Pliocene-Quaternary landscape evolution	
20	**10-21M**		Review; ***Expt Modeling of Sed Flux with B=QART***	***Syvitski and Milliman 2007***
21	10-23W		**MID TERM TEST**	
22	10-25F	Tectonic Basins	NO Class: AUGC at Dalhousie Read Ingersoll 2012 overview→	*Ingersoll, 2012 overview*
23	10-28M		Tectonic processes in a foreland basin, ***Expt Correlating foreland strat***	*DeCelles 2012 Chap 20*
24	10-30W		Rift Settings, alluvial fans	*McDonald et al 2003;*
25	11-01F	Fluvial and Alluvial Systems	Stream Environments Overview	
26	11-04M		Meandering streams, ***Expt Detrital Thermochronology in Andes***	***Coutand et al., 2006***
27	11-06W		Meandering streams	
28	11-8F		Braided streams	
29	~~11-11M~~		Reading Week, No Class	
30	~~11-13W~~		Reading Week, No Class	
31	~~11-15F~~		Reading Week, No Class	
32	11-18M		***Field Trip: Glacial Lake Shubenacadie (Late return to Dal @ 6:30)***	***Stea and Mott, 1998***
33	11-20W		Braided streams, Beaufort Formation	
34	11-22F	Societal Impacts	Active tectonics	
35	11-25M		Stream paleoflooding ***Expt Quantifying Paleoflood discharge***	
36	11-27W	Wrap up	Rates in Quaternary Sedimentary Environments	
37	11-29F		**Review for Final Exam**	
38	12-02M		TBA	
39	12-03T		TBA	

Field trips may need to be postponed, owing to weather or other factors

University Policies and Statements

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/about/leadership-governance/academic-integrity/faculty-resources/ouriginal-plagiarism-detection.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.

Faculty of Science

Student Resources and Support

University Policies and Programs

Important Dates in the Academic Year (including add/drop dates): http://www.dal.ca/academics/important_dates.html

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

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

Safety

Biosafety: http://www.dal.ca/dept/safety/programs-services/biosafety.html

Chemical Safety: https://www.dal.ca/dept/safety/programs-services/chemical-safety.html

Radiation Safety: http://www.dal.ca/dept/safety/programs-services/radiation-safety.html

Laser Safety: https://www.dal.ca/dept/safety/programs-services/radiation-safety/laser-safety.html