**APPLIED SCIENCE AND MANAGEMENT DIVISION**
**GEOL 206**
**SCHOOL OF SCIENCE**
**FALL, 2018**


# COURSE OUTLINE

# GEOL 206

# SEDIMENTARY STRATIGRAPHY

3 **CREDITS**

PREPARED BY: Mary Samolczyk, Instructor DATE: 31/05/2018

APPROVED BY: Margaret Dumkee, Dean DATE: 31/05/2018

APPROVED BY ACADEMIC COUNCIL: May 20, 2014

# SEDIMENTARY STRATIGRAPHY

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**INSTRUCTOR:** Siobhan McGoldrick, M.Sc.

**OFFICE LOCATION:** M105 (CNIM)

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**TELEPHONE:** 867-456-6958

**OFFICE HOURS:** By appointment

**CLASSROOM:** M111 (CNIM)

**TIME:** M/W 10:30-12:00 pm (lecture)
T 1:00-4:00 pm (laboratory)

**DATES:** Sept. 5 – Dec 20, 2018

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## COURSE DESCRIPTION

This course focuses on sedimentary depositional environments, stratigraphy and facies analysis, as well as the controls of sedimentary environments on the development of hydrocarbon and coal resources. Topics include sequence stratigraphy and correlation, facies analysis, international and North American stratigraphic codes, tectonic development of sedimentary basins, and hydrocarbon generation. A central focus of the course will be on the subsurface characterization of basins within Yukon and Western Canada. The sedimentology of Yukon placer and coal deposits will also be discussed. In laboratory sections, students will identify characteristics of common sedimentary facies, map and correlate sedimentary units, create stratigraphic sections and use stratigraphic understanding to assess hydrocarbon, coal, and placer gold resources. This course will also provide an introduction to the acquisition, analysis, and presentation of open-hole log and test data.

## PREREQUISITES

Mathematics 12 (OR Yukon College equivalent, MATH 060) and GEOL 105 OR permission from the course instructor.

## EQUIVALENCY OR TRANSFERABILITY

This course is transferrable with UBC EOSC 2XX, UBCO EESC 2XX, SFU EASC 201. To learn more about transferability, visit: www.bctransferguide.ca.

**LEARNING OUTCOMES**

Upon successful completion of the course, students will be able to

- properly classify and describe sedimentary rocks in outcrop, hand sample, and thin section; accurately measure and record stratigraphic sections in a field setting
- predict what types of sedimentary processes and depositional environments would characterize a particular tectonic setting and what their stratigraphic signature would be
- interpret changes in a depositional environment through time (stratigraphic change) at a variety of spatial and temporal scales based on data from sedimentary rocks and successions
- demonstrate an understanding of the origins, compositions, and occurrences of fossil fuels as well as the technologies used to produce them
- utilize different analysis methods and datasets (lithostratigraphy, chronostratigraphy, chemostratigraphy, magnetostratigraphy, etc.) to build a stratigraphic section
- construct cross sections, isopach maps, and preliminary basin models based on publically-available well log data

**COURSE FORMAT**

This course consists of two 90-minute lectures and one three-hour lab period per week. The schedule included in this course outline details the major topics covered and when those topics will be presented throughout the course. Lab exercises will be conducted in classroom, computer lab and field settings.

**ASSESSMENTS**

**Attendance & Participation**

Students are strongly encouraged to attend all lectures and laboratory exercises. Lab exercises can be completed only during lab periods and materials may not be available outside these hours. Off-campus field exercises must be completed during the allocated time with the instructor present.

**Assignments**

Weekly lab exercises (10) will be due at the start of the following lab session unless otherwise indicated by the lab instructor. Two lab exercises will require a formal report-style write-up, with requirements clearly outlined during the laboratory period. Four additional take-home lecture assignments will be assigned at regular intervals over the course of the semester.

**Tests**

There will be three exams in this course: a midterm lecture exam, a final lab exam and a final lecture exam. Students must pass the lecture final exam to achieve an overall passing grade.

**Other EVALUATION**

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| Weekly Lab Assignments | 35% (8 labs @ 3%, 2 labs @5.5%) |
| Midterm Exam | 15% |
| Final Lab Exam | 20% |
| Final Lecture Exam | 20% |
| Lecture Assignments | 10% (4 assignments @ 2.5% each) |
| Total | 100% |

**DUE DATES**

Lecture assignments are due at the start lecture on the date assigned by the instructor. Laboratory assignments will be due at the start of the following laboratory period unless otherwise indicated by the laboratory instructor. Late assignments will be graded based on the following scheme: a deduction of 10% per day up until a total deduction of 50% is reached, following that, assignments must be submitted prior to the date that the instructor hands back the graded assignment (set by the instructor), unless otherwise indicated by the instructor.

Missed exams will be assigned a grade of 0% unless re-scheduling for a valid reason is approved and determined **in advance** of scheduled exam date. If there are known conflicts with exam scheduling, please see the instructor as soon as possible to discuss an alternative examination date.

**REQUIRED TEXTBOOKS AND MATERIALS**

Boggs S. 2012. Principles of sedimentology and stratigraphy. 5$^{th}$ ed. Upper Saddle River (NJ): Pearson. 600 p.

**ACADEMIC AND STUDENT CONDUCT**

Information on academic standing and student rights and responsibilities can be found in the current Academic Regulations that are posted on the Student Services/ Admissions & Registration web page.

**PLAGIARISM**

Plagiarism is a serious academic offence. Plagiarism occurs when a student submits work for credit that includes the words, ideas, or data of others, without citing the source from which the material is taken. Plagiarism can be the deliberate use of a whole piece of work, but more frequently it occurs when students fail to acknowledge and document sources from which they have taken material according to an accepted manuscript style (e.g., APA, CSE, MLA, etc.). Students may use sources which are public domain or licensed under Creative Commons; however, academic documentation standards must still be followed. Except with explicit permission of the instructor, resubmitting work which has previously received credit is also considered plagiarism. Students who plagiarize material for assignments will receive a mark of zero (F) on the assignment and may fail the course. Plagiarism may also result in dismissal from a program of study or the College.

**YUKON FIRST NATIONS CORE COMPETENCY**

Yukon College recognizes that a greater understanding and awareness of Yukon First Nations history, culture and journey towards self-determination will help to build positive relationships among all Yukon citizens. As a result, to graduate from ANY Yukon College program, you will be required to achieve core competency in knowledge of Yukon First Nations. For details, please see https://www.yukoncollege.yk.ca/yukon-first-nations-core-competency.

**ACADEMIC ACCOMMODATION**

Reasonable accommodations are available for students requiring an academic accommodation to fully participate in this class. These accommodations are available for students with a documented disability, chronic condition or any other grounds specified in section 8.0 of the Yukon College Academic Regulations (available on the Yukon College website). It is the student's responsibility to seek these accommodations. If a student requires an academic accommodation, he/she should contact the Learning Assistance Centre (LAC) at (867) 456-8629 or lac@yukoncollege.yk.ca.

# TOPIC OUTLINE

| Module | Topics | Labs |
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| 1 | Introduction to stratigraphy and sedimentary structures<br>• **Course overview** : historical development of sedimentary geology, basic concepts, types of stratigraphy<br>• **Preliminary classification and analysis:** classification schemes, common textures and sedimentary structures, methods of analysis | **The Richthofen Formation, Whitehorse Trough (Field Trip)**<br><br>Field trip to examine the package of rocks exposed at this location and observe: 1) rock textures and composition, 2) sedimentary structures, and 3) stratigraphic relationships. Importantly in this lab you will learn fundamental sedimentary geology field skills, including rock descriptions in the field, identifying way up indicators, and measurement of stratigraphic sections using a Jacob's staff. |
| 2 | Clastic sedimentary rocks and their depositional environments<br>• **Overview of clastic sedimentary rocks and their formation**: sandstones, conglomerates, shales, etc.; sediment provenance and diagenesis<br>• **Terrestrial depositional environments** | **Sedimentary Textures and the Grain Size of Sediments**<br><br>Examine the texture of sediments, including grain size and other textural characteristics such as |

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| | **of clastic sedimentary rocks**: fluvial, colluvial, aeolian, lacustrine and glacial environments | sorting, roundness, sphericity and fabric.<br><br>**Siliciclastic Sedimentary Rocks**<br><br>Examine, describe, and classify siliciclastic sedimentary rocks (mudstones, sandstones, and conglomerates). |
| 3 | Continental-marine margins and their depositional environments<br>• **Marginal-marine environments**: deltaic, beach and barrier island, estuarine, lagoonal and tidal-flat environments<br>• **Siliciclastic marine environments**: physiography and depositional settings of shelves; transport, depositional processes and sediment types in deep-ocean environments | **Carmacks Area Geology (Field Trip)**<br><br>Field trip with the goal of 1) describe lithologies found at each site (texture, sedimentary structures, fossils, etc.), 2) examine the stratigraphic relationships and measure the thicknesses of the Tanglefoot Formation strata, and 3) learn how to construct a stratigraphic column.<br>**Carmacks Area Geology - Part 2**<br><br>The purpose of this lab section is to work with the data collected from Lab 3 and provide a detailed write. |

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| 4 | Biochemical rocks and their depositional environments<br>• **Overview of biochemical sedimentary rocks**: chemistry and mineralogy, textures of limestone and dolomite, structures and classification of carbonate rocks, origin and diagenesis of carbonate rocks<br>• **Depositional environments of** | **Carbonate Sedimentary Rocks and Paleoecology**<br><br>Describe and classify carbonate sedimentary rocks. Specifically, identifying clast type, fossil identification, as well as textural characteristics of carbonate |
| | **biochemical sedimentary rocks**: carbonate shelves, slopes/basins, organic reef environments, mixed carbonate- siliciclastic systems | sedimentary rocks. |
| 5 | Chemical and non-epiclastic sedimentary rocks and their depositional environments<br>• **Overview of chemical and non- epiclastic sedimentary rocks**: evaporites, siliceous sedimentary rocks (cherts), iron-bearing sedimentary rocks, sedimentary phosphorites, carbonaceous sedimentary rock (coal, oil shale, bitumens) | **Sedimentary Petrography**<br><br>Examine thin sections of carbonate and siliciclastic sedimentary rocks. |
| 6 | Organization of stratigraphic record; stratigraphic units and code<br>• **Organization of stratigraphic record, stratigraphic units and code**: geologic time, stratigraphic units, International Stratigraphic Guide, North American Stratigraphic Code | |
| 7 | Geochronology in sedimentary environments (chronostratigraphy)<br>• **Geochronology in sedimentary environments**: chronostratigraphy, calibration of the geologic time scale, introduction to radiochronology, event correlation and event stratigraphy | |

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| 8 | Lithostratigraphy and sedimentary facies<br>• **Lithostratigraphy and sedimentary facies**: types and descriptions of lithostratigraphic units, lithostratigraphy and depositional environments, lithocorrelation, facies analysis and facies associations | **Lithostratigraphic Correlation**<br><br>Learn about the lateral migration of facies during transgression and regression sequences. Also, how to correlate lithostratigraphic units between stratigraphic columns. |
| 9 | Biostratigraphy and chemostratigraphy | |

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| | • **Biostratigraphy**: History, biostratigraphic units, biostratigraphic zonation, biocorrelation<br>• **Chemostratigraphy**: Correlation by stable isotopes, detrital zircons, tephrochronology | |
| 10 | Magnetostratigraphy, seismic and sequence stratigraphy<br>• **Magnetostratigraphy**: general principles, sampling, measuring and displaying remnant magnetism, magnetic polarity time scales, terminology and applications of magnetostratigraphy and paleomagnetic studies<br>• **Seismic stratigraphy:** principles of reflection seismic methods, application of reflection seismic methods to stratigraphic analysis<br>• **Sequence stratigraphy**: fundamentals of sequence stratigraphy, methods and applications | |
| 11 | Tectonics and sedimentation<br>• **Tectonics and sedimentation**: plate tectonics and basins, types of sedimentary basins (divergent, intraplate, convergent, transform and hybrid settings) | |
| 12 | Basin analysis and characterization<br>• **Basin analysis and characterization**: mechanisms of basin formation, techniques and applications of basin analysis | **Correlation and Contour Maps**<br><br>Learn how to recognize biostratigraphic units and index fossils; draw specialized contour maps; and correlate geophysical gamma ray logs. |

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| 13 | Hydrocarbon development and extraction techniques<br>• **Hydrocarbon development and** | |
| | **extraction techniques**: source rocks, formation, transport and traps for petroleum; conventional and unconventional extraction techniques | |
| 14 | Western Canada case studies<br>• **Geology of the Western Canada Sedimentary Basin**: geologic setting and history, oil, gas and bitumen resources of the WCSB<br>• **Hydrocarbon resources in the Yukon**: geologic setting and history of Yukon basins; oil and gas resources in the Yukon.<br>• **Sedimentology of Yukon placer gold deposits**: depositional history , sedimentary stratigraphy of the Klondike district; gold remobilization and transport | |