**ERTH 4305 / ERTH 5305**
**CARBONATE SEDIMENTOLOGY and SEQUENCE STRATIGRAPHY**

**Instructor:** George R. Dix, Rm 2203 Herzberg Labs; george.dix@carleton.ca

The course integrates facies successions of tropical and cool-water carbonates with the character of their diagenesis within a sequence stratigraphic framework. This approach highlights the roles of oceanography, sea-level variation, and carbonate production in creating geometry and texture of sequences.

***Weekly topics***

Wk 1,2 *Carbonate Sources in a Changing Global Ocean*

Wk 3 *Carbonate Mineralogy and Geochemistry*

Wk 4 *Textures of Diagenesis*

Wk 5-7 *Marine Platform Types and Depositional Systems*

**(reading week)**

Wk 8-11 Sequence *Stratigraphy of Carbonate Platforms*

Laboratory exercises will build confidence in carbonate source identification, and use of standard tools in analysis of carbonate diagenesis and platform sedimentology and stratigraphy. Individuals will present a seminar based on literature research of the depositional and diagenetic records of a selected platform.

***Textbook***

*James, N.P., and Jones, B., 2015: Introduction to the Origin of Carbonate Rocks*)
– with additional readings assigned (see CuLearn website)

***Assessment***

| | |
|---|---|
| Lab assignments | 60 % |
| Seminar / paper | 40 % |

## Requests for Academic Accommodation

You may need special arrangements to meet your academic obligations during the term. For an accommodation request, the processes are as follows:

**Pregnancy obligation**

Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website: **carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf**

**Religious obligation**

Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website: **carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf**

**Academic Accommodations for Students with Disabilities**

If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or pmc@carleton.ca for a formal evaluation or contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with your instructor as soon as possible to ensure accommodation arrangements are made. **carleton.ca/pmc**

**Survivors of Sexual Violence**

As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and is survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: **carleton.ca/sexual-violence-support**

**Accommodation for Student Activities**

Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist.
**https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf**

For more information on academic accommodation, please contact the departmental administrator or visit: **students.carleton.ca/course-outline**

**Sept 6, 13**

***Lectures: Carbonate Sources in a Changing Global Ocean***

**Carbonate Sources** (tropical, temperate, polar)

a) skeletal
b) non-skeletal
c) reworked (detrital)
d) abiotic and biotic induced

**cast in terms of:**

- aragonite-calcite seas
- $CaCl_2$ vs $MgSO_4$ seas
- *p*CO2, CCD, and lysocline boundaries
- OMZ

**Sept 10, 17: Laboratory exercise (10 % final mark)**

- *recognition of carbonate sediment/rock framework components*
- *evaluate change in biotic abundance with time*
- *evaluate mineralogical change of skeletal carbonate with time*

**Sept 20**

***Lecture: Carbonate Mineralogy and Geochemistry***

**Pt 1: Mineralogy and geochemistry**

- magnesian calcites, dolomite, and aragonite
- mineral habit, geochemistry, diagenetic potential
- textural/mineral transitions with diagenesis

**Pt 2: Bacterial influence on mineral geochemistry**

- oxic, sulphate reduction, and methanogenesis

**Sept 24: Laboratory exercise (5 % final mark)**

geochemical and mineralogical worksheets

**Sept 27**

***Lecture: Textures of Diagenesis***
**Pt 1: Compaction effects and drivers**
**Pt 2: Porosity: evolution and occlusion**
**Pt 3: Cementation: types, texture, and distribution**

**Oct 1: Laboratory exercise (5 % of final mark)**
- cement and porosity types

**Oct 4, 11, 18**

***Lectures: Marine Platform Stratigraphy and Depositional Systems***
**Pt 1. Standard (Micro)Facies Models**
- platform types, oceanographic factors, and temperature controls
- facies distribution

**Pt. 2. Typical Facies Successions**
- tropical, temperate, siliciclastic-carbonate

**Oct 15, 22: Laboratory exercise (10 % final mark)**
- facies successions across a platform

**Oct 22-26 (reading week)**

**Nov 1, 8, 15**

***Lectures: Sequence Stratigraphy of Carbonate Platforms***
**Pt 1: Definition and Seismic Framework**
- rules and patterns

**Pt 2: Base Level controls**
- rules and patterns

**Pt 3: Reciprocal sedimentation**
- significance relation to base level

**Laboratory exercises:**
Oct. 29: regional stratigraphic patterns, platform development **(5% of final mark)**
Nov. 5, 12, 19: detailed seismic / sequence stratigraphy **(25% of final mark)**

**Nov 22**

***Lecture: Integrated Diagenesis and Sequence Stratigraphy***
**stratigraphic patterns, controls, and significance**

**Nov 26 – no lab (or used as overflow lab)**

**Dec 3 and 7 (Mon schedule)**

## Seminars: *Tropical and Temperate Latitude Platforms*

**(40% of final mark)**

**Evaluation**

1) a 30-minute **seminar**; may include PPTx presentation and/or discussion

2) an **Extended Abstract** in the form of a manuscript to be submitted, and includes, in the following order: Title page with title, author, and affiliation; 5 pages of text (double space, font size 12, Times Roman) divided accordingly into titled sections and sub-headings; List of References; figures (no limit, but placed at end of paper); tables (if needed, also placed at end of paper); and a Figure Caption page(s). The submission must be in the organizational style of the Canadian Journal of Earth Sciences.

**Possible Platforms (or your choice)**

a) Middle Ordovician, eastern Laurentia
b) Devonian Helderburg (east Laurentia)
c) Devonian, Swan Hills platform/reefs (Alberta)
d) Devonian, Leduc platform/reefs (Alberta)
e) Permian reef complex (west Texas, New Mexico)
f) Belize platform (modern)
g) Sverdrup Basin platforms
h) European examples
i) Australian examples

**Course Requirements for graduate (ERTH 5305) level instruction**

There is no change if the student is at the M.Sc.-level taking the course as a 4000-level course. Otherwise, the graduate student must compare a temperate with tropical carbonate platform AND produce an essay-scale report on their findings in addition to the oral presentation or discussion reporting their findings.