UNIVERSITY OF CALGARY

UNIVERSITY OF CALGARY
FACULTY OF SCIENCE
DEPARTMENT OF GEOSCIENCE
COURSE OUTLINE
WINTER 2016 (January 8, 2016 version)

1. **Course:** Geology 699.02, Advanced Carbonate Sedimentology

   Lecture Sections:

   L01: MoWeFr, 13:00-13:50, ES 162
   For a listing of all lab sections corresponding with this course, please see the following link:
   http://geoscience.ucalgary.ca/geoscience_info/courses/w16

   Instructor, Dr. Benoit Beauchamp, Office: ES 146, Tel. No. 403-220-8266, e-mail address, bbeaucha@ucalgary.ca,
   Office Hours: Fri 2-4 pm or by appointment

   Geoscience Department ES 118, 403-220-5841, geoscience.ucalgary.ca, geoscience@ucalgary.ca

2. **Prerequisites:** Consent of the Department. See section 3.5.C in the Faculty of Science section of the online Calendar (www.ucalgary.ca/pubs/calendar/current/sc-3-5.html)

3. **Grading:** The University policy on grading and related matters is described sections F.1 and F.2 of the online University Calendar. In determining the overall grade in the course the following weights will be used:

Quiz 1	08%
Quiz 2	08%
Quiz 3	08%
Quiz 4	08%
Laboratory Report	50%
Comprehension/Application Quiz	18%

All lecture exams are mostly short answer type questions including numerical calculations from the lab. Note that all the materials covered in the labs are fair game for the lecture exams. **Students need to successfully complete (obtain >50%) all components (lab and lecture) to get a passing grade.**

Each piece of work (laboratory report, exam) submitted by the student will be assigned a percentage score. The student's average percentage score for the various components listed above will be combined with the indicated weights to produce an overall percentage for the course, which will be used to determine the course letter grade, bearing in mind that an F grade will result if the student does not pass the Final Examination. The conversion between course percentage and letter grade is given below.

Letter Grade	Percent
A+	>92
A	86-92
A-	82-85
B+	77-81
B	74-76
B-	71-73
C+	67-70
C	62-66
C-	58-61
D+	54-57
D	50-53
F	<50

4. **Missed Components of Term Work:** The regulations of the Faculty of Science pertaining to this matter are found in the Faculty of Science area of the Calendar in Section 3.6. It is the student's responsibility to familiarize himself/herself with these regulations. See also Section E.6 of the University Calendar.

5. **Scheduled out-of-class activities:** N/A

   REGULARLY SCHEDULED CLASSES HAVE PRECEDENCE OVER ANY OUT-OF-CLASS-TIME-ACTIVITY. If you have a clash with this out-of-class-time-activity, please inform your instructor as soon as possible so that alternative arrangements may be made for you.

6. **Course Materials:**

   Mandatory textbook:
   Origin of Carbonate Sedimentary Rocks (2015), Noel. P. James and Brian Jones, Wiley, 446 p.

7. **Examination Policy:** No electronic or written aids (e.g. cell phones, tablets, computers, PDAs, notes, textbooks) will be allowed during writing of any exams. Non-programmable calculators will be permitted to answer quantitative questions on exams, if applicable, and permission to do this will be clearly indicated on the examination paper. Students should also read the Calendar, Section G, on Examinations.

8. **Writing across the curriculum statement:** In this course, the quality of the student's writing in laboratory reports will be a factor in the evaluation of those reports. See also Section E.2 of the University Calendar.

9. **OTHER IMPORTANT INFORMATION FOR STUDENTS:**

   (a) **Academic Misconduct:** (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases. A single offence may lead to disciplinary probation or suspension or expulsion. The Faculty of Science follows a zero tolerance policy regarding dishonesty. Please read the sections of the University Calendar under Section K. Student Misconduct to inform yourself of definitions, processes and penalties

   (b) **Assembly Points:** In case of emergency during class time, be sure to FAMILIARIZE YOURSELF with the information on assembly points.

   (c) **Student Accommodations:** Students needing an Accommodation because of a Disability or medical condition should contact Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities available at http://www.ucalgary.ca/policies/files/policies/procedure-for-accommodations-for-students-with-disabilities_0.pdf. Students needing an Accommodation in relation to their coursework or to fulfil requirements for a graduate degree, based on a Protected Ground other than Disability, should communicate this need, preferably in writing, to the Associate Head of Geoscience, Dr. E.S. Krebes by email krebes@ucalgary.ca or phone 403-220-5850.

   (d) **Safewalk:** Campus Security will escort individuals day or night (http://www.ucalgary.ca/security/safewalk/). Call 220-5333 for assistance. Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.

   (e) **Freedom of Information and Privacy:** This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPP). As one consequence, students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page. For more information see also http://www.ucalgary.ca/secretariat/privacy.

   (f) **Student Union Information:** VP Academic Phone: 403 220-3911 Email: suvpaca@ucalgary.ca
   SU Faculty Rep. Phone: 403 220-3913 Email: science1@su.ucalgary.ca, science2@su.ucalgary.ca and science3@su.ucalgary.ca;
   Student Ombuds Office: 403-220-6420 Email: ombuds@ucalgary.ca; http://ucalgary.ca/provost/students/ombuds

   (g) **Internet and Electronic Device Information:** You can assume that in all classes that you attend, your cell phone should be turned off unless instructed otherwise. Also, communication with other individuals, via laptop computers, Blackberries or other devices connectable to the Internet is not allowed in class time unless specifically permitted by the instructor. If you violate this policy you may be asked to leave the classroom. Repeated abuse may result in a charge of misconduct.

(h) U.S.R.I.: At the University of Calgary, feedback provided by students through the Universal Student Ratings of Instruction (USRI) survey provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selectin g courses (www.ucalgary.ca/usri). Your respons es make a difference – please participate in USRI Surveys.

Department Approval: ORIGINAL SIGNED Date: January 27/16

Associate Dean's Approval for Alternate
final examination arrangements: ORIGINAL SIGNED Date: January 27/16

Tentative Course(*) and Lab(**) schedule GLGY 699.02 (W2016)

W	Monday (lecture) **1:00 – 1:50 ES162**	Wednesday (lecture) **1:00 – 1:50 ES162**	Friday (lecture) **1:00 – 1:50 ES162**	Tuesday-Thursday (Lab) **Optional(**)** **B01 Tu 8:00-10:50 ES 147** **B02 Tu 11:00-1:50 ES 147** **B03 Tu 2:00-4:50 ES 147** **B04 Tu 5:00-7:50 ES 147** **B05 Th 8:00-10:50 ES 147** **B06 Th 11:00-1:50 ES 147** **B07 Th 2:00-4:50 ES 147** **B08 Th 5:00-7:50 ES 147**
1	1A Jan 11 2016 **Course Introduction** • Course info • Review of previous courses • Review of topics to be covered in this course	1B Jan 13 2016 **Introduction to Life and the Fossil Record** • Origin of life • Tree of life • Microbial life • Cambrian Explosion • Fossils through time • Evolution and mass extinctions • Fossil preservation	1C Jan 15 2016 **Constituents of Carbonate Rocks – I** • Grain, matrix, cement • Fossils - I	Jan 12, 14 2016 **No Lab**
2	2A Jan 18 2016 **Constituents of Carbonate Rocks - II** • Fossils – II	2B Jan 20 2016 **Classifications of Carbonate Rocks** • Clastic clone • Folk (1958, 1962) • Dunham (1962) • Embry and Klovan (1969)	2C Jan 22 2016 **Chemistry of Calcium Carbonate** • Aquatic carbonate system • $CaCO_3$ equilibrium • pH buffering • CO_2 degassing • Silicate weathering • Earth system / rock cycle • Mineralogy • Chemistry (Mg/Ca; Sr; Fe)	Jan 19, 21 2016 **Basics of Petrographic Microscope** **Constituents** Corals Stromatoporoids Foraminifers
3	3A Jan 25 2016 **Carbonate Factories through Time - I** • Sun radiation • Latitudinal range of carbonate deposition • Photic zone • Nutrients	3B Jan 27 2016 **Carbonate Factories through Time - II** • Carbonate factories • Carbonate-forming fossils in time • Aragonite vs calcite seas	3C Jan 29 2016 **Carbonate Facies Analysis and Facies Models** • Differences between clastic and carbonate facies analysis • Response to sea level fluctuations • Microfacies analysis • Bathymetric interfaces (Tidewater, FWWB, SWWB, Photic Zone, Lysocline, CCD, O2 minimum) • Standard model • Overview of all carbonate environments	Jan 26, 28 2016 **Constituents** Brachiopods Echinoderms Bryozoans Bivalves Ostracods
4	4A Feb 01 2016 **Quiz 1** **Warm Water Reef_Modern** • Biological processes • Barrier reefs • Atolls • Classification • Modern examples • Reef bleaching	4B Feb 03 2016 **Warm Water Reef_Ancient - I** • Biological processes • Deep oligophotic vs framework reef • Classification • Reef types and distribution	4C Feb 05 2016 **Warm Water Reef_Ancient - II** • Ancient examples • Devonian of Western Canada	Feb 02, 04 2016 **Constituents** Algae Green Red Blue Green Microbial fabric
5	5A Feb 08 2016 **Carbonate Slopes - I** • Stratal pattern • Slopes • Processes • Deposits • Modern examples • Ancient examples	5B Feb 10 2016 **Carbonate Slope_Modern and Ancient - II** • Stratal pattern • Slopes • Processes • Deposits • Modern examples • Ancient examples	5C Feb 12 20156 **Ordovician Escarpment** *Guest: Keith Dewing*	Feb 09, 11 2016 **Constituents** Other grains Oncoids Ooids Aggregates Intraclasts

6	6A Feb 15 2016 **Reading Week - No class**	6B Feb 17 2016 **Reading Week - No class**	6C Feb 19 2016 **Reading Week - No class**	Feb 16, 18 2016 **Reading Week – No Lab**
7	7A Feb 22 2016 **Shelf and Lagoon_Modern** Biological processes • Energy settings • Salinity restriction • Teepee, fenestral fabric • Sea grass • Modern examples	7B Feb 24 2016 **Shelf and Lagoon_Ancient** • Ancient examples • Enclosed shallow to deep basins o Humid o Evaporative o Anoxic	7C Feb 26 2016 **Peritidal carbonates** • Tidal Flats • Beaches • Eolianites	Feb 23, 25 2016 **No Lab**
8	8A Feb 29 2016 **Quiz 2** **Lacustrine carbonates** • Lacustrine carbonates	8B Mar 02 2016 **Cool-water Carbonates_Modern** • Thermocline • Latitudinal distribution • Linkage to oceanography • Open ramp models • Heterozoan biota	8C Mar 04 2016 **Cool-water Carbonates_Ancient** • Heterozoan carbonates in space and time • Clastic-like systems • Polar carbonates • Ancient examples	Mar 01, 03 2016 **Classification** Dunham's Floatstone – Rudstone **Microfacies Analysis I** Warm-water system Shelf Reef Slope
9	9A Mar 07 2016 **Lime Mud Factory - I** • In situ factories • Whitings • Microbial carbonates • Bioerosion	9B Mar 09 2016 **Lime Mud Factory - II** • Mud mounds	9C Mar 11 2016 **Methane seep carbonates** • Modern setting • Ancient examples • Arctic examples • Hybrid reefs	Mar 08, 10 2016 **Microfacies Analysis II** Warm-water system Shelf Reef Slope
10	10A Mar 14 2016 **Oceanic carbonates I** • Principles of oceanography o Atmospheric cells o Wind patterns o Upwelling o CCD. acidification o Carbon pump • Pelagic carbonates o Planktonic forams o Coccoliths, chalk	10B Mar 16 2016 **Oceanic carbonates II** **Tunisia's carbonate systems and petroleum development** *Guest: Makram Hedhli*	10C Mar 18 2016 **Quiz 3** **Introduction to Carbonate Diagenesis I** • Introduction • Recrystallization • Neomorphism • Dissolution	Mar 15, 17 2016 **Microfacies Analysis** Cool-water system Shelf Mud mounds
11	11A Mar 21 2016 **Carbonate Diagenesis II** • Type of porosity • Types of cements • Paragenetic sequence • Analytical tools and isotopes	11B Mar 23 2016 **Submarine Diagenesis** • Submarine diagenetic zones • Cement types • Water pumping • Beachrock • Sea floor fans	11C Mar 25 2016 **No Class – Good Friday**	Mar 22, 24 2016 **Diagenesis** Submarine Meteoric Burial **Dolomite** Non planar Euhedral Subhedral Microcrystalline Replacement Cement **Paragenetic sequence**
12	12A Mar 28 2016 **Meteoric diagenesis I** • Dissolution • Precipitation • Role of CO_2 • Karsts and caves • Vadose cementation • Phreatic cementation • Mixing zone	12B Mar 30 2016 **Meteoric diagenesis II** • Soil • Caliche profiles • Carbonate-rich soil profiles • Recognizing subaerial unconformities in carbonate cycles • *Microcodium* *Guest: Dr. Pavel Kabanov*	12C Apr 01 2016 **Burial diagenesis** • Compaction / stylolites • Syntaxial overgrowth • Sparry calcite • P-T gradients	Mar 29, 31 2016 **No Lab**
13	13A Apr 04 2016 **Dolomite** • Dolomite problem • Processes • Models • Hydrothermal	13B Apr 06 2016 **Carbonate Petroleum Plays I**	13C Apr 08 2016 **Carbonate Petroleum Plays II**	Apr 05, 07 2016 **No Lab**

14	14A Apr 11 2016 **Quiz 4** **USRI Surveys**	14B Apr 13 2016 **No class**	Apr 15 2016 **No class**	Apr 12, 14 2016 **No Lab**

(*) Students who take GLGY 699.02 Advanced Carbonate Sedimentology are required to attend the lectures in GLGY 483 Carbonate Sedimentology. They also take the same in-class quizzes as the GLGY 483 students on the same days these quizzes are scheduled and they are marked for them.

(**) If they wish, students who take GLGY 699.02 Advanced Carbonate Sedimentology can attend any or all of the weekly laboratory sessions that are mandatory for GLGY 483 students. The GLGY 699.02 students however, do not have to complete the weekly lab assignments. If the GLGY 699.02 students wish to attend any of the GLGY 483 lab sessions, they will need to consult with the Teaching Assistant responsible for the lab section in question to ensure microscope availability.

Students enrolled in GLGY 699.02 Advanced Carbonate Sedimentology have to conduct an independent laboratory exercise that consists of both thin-section examination and core logging of Devonian carbonates of Western Canada. A single report due the end of the term is produced by each student.

In addition to the in-class quizzes and the laboratory report, the GLGY 699.02 students' grades are completed by a written quiz at the end of the term to assess the students' overall comprehension of carbonate sedimentology.