



Course Syllabus: Fundamentals of Carbonate Geology - ERPE 210

Division	Physical Science and Engineering Division
Course Number	ERPE 210
Course Title	Fundamentals of Carbonate Geology
Academic Semester	Fall
Academic Year	2019/2020
Semester Start Date	08/25/2019
Semester End Date	12/10/2019
Class Schedule (Days & Time)	01:00 PM - 02:30 PM Sun Wed , 04:00 PM - 05:30 PM Mon

Instructor(s)				
Name	Email	Phone	Office Location	Office Hours
Volker Christian Vahrenkamp	VOLKER.VAHRENKAMP@KAUST.EDU.SA	+966128087230	3217, 5, Al-Kindi (bldg. 5)	I have an open door policy. Fixed hours will be announced after the first lecture.

Teaching Assistant(s)	
Name	Email
tbd	tbd

Course Information	
Comprehensive Course Description	<p>This course addresses key fundamentals of Carbonate Geology. An overview will be given covering all aspects of carbonate geology from historical development of the field, to the mineralogy of carbonate rocks, their components diagenesis and classification systems.</p> <p>Initial learnings will be the concept of uniformitarianism, and its limitation in view of changes in earth environments and evolution of life through time.</p> <p>The making of carbonate rocks will be investigated by a systematic journey through depositional systems and their products from mud to reef rock and carbonate sands to deep marine carbonate ooze. The impact of environmental factors such as water depth, current and wave energy, sun light, nutrients, etc. will be weighed.</p> <p>Following the introduction of components and depositional environments aspects of stratigraphy will be considered: facies, facies belts, facies stacking and depositional sequences.</p> <p>In the last phase, the course will provide an overview on how carbonate sediments turn into carbonate rocks through diagenesis. What is diagenesis? Introduced will be its chemistry, timing (syn-depositional to late), environments (marine to burial), mineral transitions including dolomitization, the products of diagenesis and how to recognize and classify them.</p> <p>After having achieved an understanding of the deposition of sediments and their transition into rocks, attention will shift to the holes in the rock. A brief introduction is offered of the carbonate porosity system, its genesis, classification and the associated property of permeability.</p> <p>Finally, the concepts of changes over time (paragenesis) will be introduced from component genesis to sediment deposition, the sequence of diagenetic events over time to burial history.</p> <p>There will be 2 lectures of 1.5 hours per week. Lectures are accompanied by an additional mandatory laboratory session of 1.5 hours per week. Components and concepts will be demonstrated with samples, rocks and thinsections and exercises.</p> <p>Provisionally, 3 field excursions are planned. Two 1-day weekend field excursions near KAUST will provide insights into carbonate depositional environments and how sediments turn into rocks, diagenesis & porosity systems. The third trip will be a 2 ½ day weekend trip to Abu Dhabi to investigate modern depositional systems of the Arabian Gulf.</p> <p>Note: students are expected to have at least basic familiarity with geology, sedimentary processes and evolution.</p>

Course Description from Program Guide	Historical development of carbonate fields. Carbonates mineralogy. Depositional environments. Classification systems. Evolution from sediments to rocks. Diagenesis: driving forces and physical environments. Dolomitization. Generation of rock sequences: facies, facies belts, facies stacking and stratigraphy. The role of porosity, its creation, alteration and classification. Carbonate rock systems for the oil industry. Lab Work: core description, petrography, microscopy, petrographic and geochemical tools.
Goals and Objectives	After completing this course, students will: <ul style="list-style-type: none"> - Understand carbonate minerals and the basic chemistry of the carbonate system - understand the carbonate factory, - be able to identify components of carbonate rocks - be able to classify carbonate rocks - understand the concepts of depositional environments, facies and facies belts - understand the principles of diagenesis and the tools available to decipher diagenetic processes - recognize pores and be able to classify pore systems understand the overall heterogeneity of carbonate reservoirs as a function of carbonate sedimentology and diagenesis.
Required Knowledge	Basic familiarity with geology, sedimentary processes and evolution. Imagination is helpful.
Reference Texts	Origin of Carbonate Sedimentary Rocks, by Noel P. James & Brian Jones, ISBN 978-1-118-65270-1, 464 pages, Aug. 2015, American Geophysical Union A Color Guide to the Petrography of Carbonate Rocks: Grains, textures, porosity, diagenesis, by Peter A. Scholle and Dana S. Ulmer-Scholle, ISBN 978-1-62981-004-1, AAPG Memoir Volume 77 Scientific papers and additional books
Method of evaluation	20.00% - Quiz(zes) 10.00% - Oral presentation 15.00% - Midterm exam 25.00% - Group Project(s) 30.00% - Final exam
Nature of the assignments	- Group Project: Research project based on samples collected on a field excursion. Class presentation and short illustrated report - Homework assignments for labs: drawing of fossils, investigation of thinsections, thinsection photography (mineralogy, components, classification, facies, diagenesis, paragenetic sequence) - reading of a scientific paper and summerizing it in a 10min presentation before lectures - Quizzes: on assigned weekly reading
Course Policies	Attendance: Each student is expected to prepare for and attend all of the classes, lab sessions and field excursion during the semester. Punctuality is required. It is the students responsibility to contact the instructor prior to absence, alert him to late assignments and discuss with the instructor how to make up. Documentation is required for excused absences in accordance with university policy. Academic Integrity: As a member of the Kaust community you are required to demonstrate integrity. Lying, cheating or stealing will not be tolerated. Wireless communication systems of all kind must be turned off while in the class room, during labs and field excursions, especially cell phones.
Additional Information	

Tentative Course Schedule

(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Sun 08/25/2019	no class
1	Mon 08/26/2019	no class
1	Wed 08/28/2019	Carbonate Geology – Introduction, Historical Overview; Course Organization, Lab Hour
2	Sun 09/01/2019	Carbonate Chemistry & Mineralogy.
2	Mon 09/02/2019	Lab: Collection, Thinsection, Microscopes, Cameras
2	Wed 09/04/2019	The Carbonate Factory: Components, Textures, Fabric - Rock Classifications
3	Sun 09/08/2019	Environmental Factors
3	Mon 09/09/2019	Lab: Basic Components, Textures, Fabric - Rock Classifications
3	Wed 09/11/2019	The carbonate factory: 1 Microbes and Algae
4	Sun 09/15/2019	The carbonate factory: 2 Single Cells and Shells
4	Mon 09/16/2019	Lab: Components
4	Wed 09/18/2019	The carbonate factory: 3 Echinoderms and Colonial Invertebrates
5	Sun 09/22/2019	University holiday
5	Mon 09/23/2019	Saudi National Day
5	Wed 09/25/2019	Lab: Components
6	Sun 09/29/2019	Carbonate Depositional Systems: An Overview
6	Mon 09/30/2019	Lab: Components
6	Wed 10/02/2019	Warm water neritic realms
7	Sun 10/06/2019	Cool-water neritic realms
7	Mon 10/07/2019	Lab: Depositional environments & their typical components
7	Wed 10/09/2019	Muddy Perital Carbonates
8	Sun 10/13/2019	Evaporites
8	Mon 10/14/2019	Lab: Depositional environments & their typical components
8	Wed 10/16/2019	Carbonate Lagoons
9	Sun 10/20/2019	Sand bodies
9	Mon 10/21/2019	Mid-Semester Break
9	Wed 10/23/2019	Mid-Semester Break
10	Sun 10/27/2019	Modern Reefs
10	Mon 10/28/2019	Lab: Depositional environments & their typical components
10	Wed 10/30/2019	Ancient Reefs
11	Sun 11/03/2019	Carbonate Slopes
11	Mon 11/04/2019	Lab: Depositional environments & their typical components
11	Wed 11/06/2019	Deep Water Pelagic Carbonates
12	Sun 11/10/2019	Lacustrine & Springs
12	Mon 11/11/2019	Lab: Depositional environments & their typical components
12	Wed 11/13/2019	Basic Elements of Stratigraphy
13	Sun 11/17/2019	Sequence Stratigraphy Overview
13	Mon 11/18/2019	Stratigraphic Exercise
13	Wed 11/20/2019	Carbonate Ramps vs Platforms

14	Sun 11/24/2019	Carbonate Diagenesis Overview & Chemistry
14	Mon 11/25/2019	Diagenesis Exercise
14	Wed 11/27/2019	Diagenetic Environments, Paragenetic Sequence, Burial Graphs
15	Sun 12/01/2019	Porosity Types and Classification
15	Mon 12/02/2019	Lab: Porosity types
15	Wed 12/04/2019	Class Review
16	Sun 12/08/2019	Exams
16	Mon 12/09/2019	Exams

Note

The instructor reserves the right to make changes to this syllabus as necessary.