



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	2018/2019
Semester Start Date	08/26/2018
Semester End Date	12/11/2018
Class Schedule (Days & Time)	01:00 PM - 02:30 PM Sun Wed

Instructor(s)				
Name	Email	Phone	Office Location	Office Hours
Volker Christian Vahrenkamp	VOLKER.VAHRENKAMP@K AUST.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>Next, the course will investigate 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 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>Lectures are accompanied by a 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	<p>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.</p>
Goals and Objectives	<p>After completing this course, students will:</p> <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 - identify diagenetic products in thinsection and derive paragenetic sequences - recognize pores and be able to classify pore systems <p>understand the overall heterogeneity of carbonate reservoirs as a function of carbonate sedimentology and diagenesis.</p>
Required Knowledge	<p>Basic familiarity with geology, sedimentary processes and evolution. Imagination is helpful.</p>
Reference Texts	<p>Origin of Carbonate Sedimentary Rocks, by Noel P. James & Brian Jones, ISBN 978-1-118-65270-1, 464 pages, Aug. 2015, American Geophysical Union</p> <p>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</p> <p>Scientific papers and additional books</p>
Method of evaluation	<p>15.00% - Others - Please specify 10.00% - Quiz(zes) 20.00% - Midterm exam 15.00% - Homework /Assignments 15.00% - Group Project(s) 25.00% - Final exam</p>
Nature of the assignments	<ul style="list-style-type: none"> - Group Project: Research project based from field excursion. Presentation and illustrated reports - Homework assignments for labs: drawing of fossils, investigation of thinsections, thinsection photography (mineralogy, components, classification, facies, diagenesis, paragenetic sequence) - Others: anotated field trip reports - Quizzes: on assigned weekly reading

Course Policies	<p>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.</p> <p>Academic Integrity: As a member of the Kaust community you are required to demonstrate integrity. Lying, cheating or stealing will not be tolerated.</p> <p>Wireless communication systems of all kind must be turned off while in the class room, during labs and field excursions, especially cell phones.</p>
Additional Information	

Tentative Course Schedule

(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Sun 08/26/2018	No lecture.
1	Wed 08/29/2018	Carbonate Geology – Introduction, Historical Overview; Course Organization, Lab Hour
2	Sun 09/02/2018	Carbonate Chemistry & Mineralogy.
2	Wed 09/05/2018	The Carbonate Factory: Components, Textures, Fabric - Rock Classifications
3	Sun 09/09/2018	Environmental Factors
3	Wed 09/12/2018	The carbonate factory: 1 Microbes and Algae
4	Sun 09/16/2018	The carbonate factory: 2 Single Cells and Shells
4	Wed 09/19/2018	The carbonate factory: 3 Echinoderms and Colonial Invertebrates
5	Sun 09/23/2018	Carbonate Depositional Systems: An Overview, Lacustrine, Springs
5	Wed 09/26/2018	Carbonate Depositional Systems: Warm water neritic realms
6	Sun 09/30/2018	Carbonate Depositional Systems: Cool-water neritic realms
6	Wed 10/03/2018	Depositional Systems: 1 Muddy Perital Carbonates
7	Sun 10/07/2018	Depositional Systems: 2. Tidal sand bodies
7	Wed 10/10/2018	Depositional Systems: 3. Modern Reefs
8	Sun 10/14/2018	Depositional Systems: 4 Ancient Reefs
8	Wed 10/17/2018	Depositional Systems: 5 Slopes
9	Sun 10/21/2018	Depositional Systems: 6 Deep Water
9	Wed 10/24/2018	Facies Belts, Walters Law, Stratigraphy
10	Sun 10/28/2018	Mid-Term
10	Wed 10/31/2018	The chemistry of carbonate diagenesis
11	Sun 11/04/2018	Diagenesis: 1 Syndepositional & Early Marine
11	Wed 11/07/2018	Diagenesis: 2a Meteoric
12	Sun 11/11/2018	Diagenesis: 2b Karst
12	Wed 11/14/2018	Diagenesis: 3 Burial (Compaction, Stylolites, ...)
13	Sun 11/18/2018	Diagenesis: 4 Dolomitization
13	Wed 11/21/2018	Diagenesis: 5 Late Dolomitization
14	Sun 11/25/2018	Porosity Types and classification
14	Wed 11/28/2018	Porosity Types and classification
15	Sun 12/02/2018	Review
15	Wed 12/05/2018	Final lab project report/presentation
16	Sun 12/09/2018	Final lab project report/presentation

Note

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