جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Course Syllabus: Special Topics - ERPE 290

Division	Physical Science and Engineering Division
Course Number	ERPE 290
Course Title	Special Topics
Academic Semester	Summer
Academic Year	2018/2019
Semester Start Date	06/16/2019
Semester End Date	08/08/2019
Class Schedule (Days & Time)	10:00 AM - 12:00 PM | Mon Tue Wed

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Volker Christian Vahrenkamp	VOLKER.VAHRENKAMP@KAUST.EDU.SA	+966128087230	3217, 5, Al-Kindi (bldg. 5)	open door policy

Teaching Assistant(s)

Name	Email
Alex Petrovic	alex.petrovic@kaust.edu.sa

Course Information

Comprehensive Course Description	This course will teach over the duration of 8 weeks with 3 lectures per week on the subject of carbonate diagenesis. Part one covers the transition of primary carbonate sediments and precipitates to sedimentary rocks via biological, chemical and physical alteration. In the second part, the course will investigate the influence of these processes on the creation of pore systems in limestone and dolomite sequences that harbor a large part of the worlds aquifer and hydrocarbon reserves. Initially the fundamentals of the chemical equilibrium system of carbonate minerals will be explored. Next, the diverse pathways will be investigated that drive the conversion of carbonate sediments to rocks based on the chemical and physical characteristics of the natural environments that carbonate sediments encounter. In this section we will cover all major diagenetic geological environments (marine, near-surface fresh water, intermediate depth fresh water and deep burial). At this stage participants will understand the drivers and environments that lead to the conversion of meta-stable primary organic and an-organic carbonate sediments (Aragonite, High-Magnesium Calcite) to more stable carbonate rocks (Low-Magnesium Calcite and dolomite). A key point of the course will be to understand how the chemical composition of carbonates relates to the diagenetic environments from where they originated. Consequently, significant emphasis will be on appreciating analytical techniques that can be used to determine the chemical composition of carbonate minerals. This includes petrography, rock staining techniques, isotope and trace-element measurement and standard and advanced microscope techniques. The final segment of the course will explore the consequences of the diagenetic processes on the development of porosity and permeability in limestone and dolomite rock sequences. Cementation, leaching, pore sizes, pore throat sizes, pore shapes, single – dual – triple pore systems. How and when are they generated? How do they influence fluid flow in the subsurface? What is their impact on recovery of hydrocarbons? As part of this segments students will learn about pore classification systems, paragenetic sequences, burial plots and techniques that have been developed to determine pore characteristics (mercury injection, porositons, etc.) The course will be taught using Active Learning Techniques. As such it will be centered in the ANPERC petrography lab. After short introductory lectures on special topics small groups of students will self-investigate aspects of these topics using samples from the ANPERC rock collection. As part of the deliverables, they will report their results with the course plenum. The grade will be derived from the team projects and lab reports and an individual final paper & presentation.
Course Description from Program Guide	Specialized MS level courses that cover subjects of particular interest, augment 200- or 300-level courses with in-depth coverage of the foundations, or provide computational applications and extended projects. Special Topics may also introduce new scientific fields and research areas, or broaden and challenge the students experience and expertise in other ways.
Goals and Objectives	In the initial stage stage participants will understand the drivers and environments that lead to the conversion of meta-stable primary organic and anorganic carbonate sediments (Aragonite, High-Magnesium Calcite) to more stable carbonate rocks (Low-Magnesium Calcite and dolomite). The second stage will provide an overview of the diagenetic environments that are commonly associated with the alteration of carbonate rocks and will teach the students how to recognize these in rocks, thin sections and geochemical data. In the third stage students will learn about pore classification systems, paragenetic sequences, burial plots and techniques that have been developed to determine pore characteristics (mercury injection, porositons, etc.)
Required Knowledge	ERPE210 (Fundmentals of Carbonate Sedimentology) or similar
Reference Texts	Origin of Carbonate Sedimentary Rocks, by Noel P. James & Brian Jones, ISBN 978-1-118-65270-1, 464 papges, 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 excerpts of other books will be provided
Method of evaluation	**30.00**% - Course Project(s) **30.00**% - Scientific review article presentation **30.00**% - Homework /Assignments **10.00**% - Active participation
Nature of the assignments	1) review of scientific papers and summary presentation during class 2) evaluation of diagenetic parameters in thinsections - lab reports 3) Final course project on deciphering diagenesis and pore system of a given rock sample (writen and oral)

Course Policies	Attendance: Each student is expected to prepare for and attend all of the classes and lab sessions during the semester. Punctuality is required. It is the students responsibility to contact the instructor prior to absence, alert him to late assignements and discusss with the instructor how to make up. Documentation is required for excused absences in accordance with university policy. Academic Integrety: As a member of the Kaust community you are required to demonstrate integrity. Lying, cheating or stealing will not be tolerated. Wireless communication systems (especially cell phones) must be turned off while in the class room and during labs unless part of the ongoing teaching.
Additional Information	

Tentative Course Schedule

(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Mon 06/17/2019	Introduction course overview, way of working, intro to diagenesis, microscopes, thinsections, staining, ...
1	Tue 06/18/2019	Chemistry, Methods Carbonate system, isotopes trace elements, X-ray, NMR, SEM...
1	Wed 06/19/2019	Chemistry - Shallow burial processes
2	Mon 06/24/2019	Pore Systems Choquette & Pray, Lucia, Clerke
2	Tue 06/25/2019	Dolomitization I Chemistry / Physical requirements
2	Wed 06/26/2019	Early Marine 1 cements
3	Mon 07/01/2019	Early Marine 2 Micritization
3	Tue 07/02/2019	Diagenesis of young limestones Vadose
3	Wed 07/03/2019	Diagenesis of young limestones shallow phreatic
4	Mon 07/08/2019	Deep Freshwater Phreatic
4	Tue 07/09/2019	no lecture - self study on term project
4	Wed 07/10/2019	no lecture - self study on term project
5	Mon 07/15/2019	Karst
5	Tue 07/16/2019	Deep Burial 1 (Machel)
5	Wed 07/17/2019	Deep Burial 2 (Ehrenberg)
6	Mon 07/22/2019	Dolomitization 2 Reflux, Mixing Zone
6	Tue 07/23/2019	Dolomitization 3 Burial
6	Wed 07/24/2019	Advanced Methods geochemical analysis, advanced microscopy
7	Mon 07/29/2019	Porosity & permeability Thomeer functions - Ed Clerke MICP analysis
7	Tue 07/30/2019	Paragenetic Sequences, Burial plots
7	Wed 07/31/2019	Project presentations
8	Mon 08/05/2019	Project presentations
8	Tue 08/06/2019	lab work & course review
8	Wed 08/07/2019	lab work

Note

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