

Carbonate chemistry

INSTRUCTOR

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MEETING PATTERN & LOCATION

Wednesday 2:00pm-3:40pm Geology Building 404, 2 credits

MS students (GEOL 5215, CRN 17392)

COURSE DESCRIPTION

Carbonate minerals are common and important components of sediments, soils and sedimentary rocks, and also exist as components of metamorphic (e.g. marble) and igneous rocks (carbonatites). Environmental conditions are often intimately linked to carbon cycling (e.g. pH, redox conditions, or CO₂ pressure in the atmosphere). Carbonates, as the main inorganic carbon pool on Earth's surface, play a key role in regulating these cycles. A considerable portion of hydrocarbon reservoirs are hosted in carbonates and carbonate cements strongly affect the porosity and permeability of rocks and thus their properties as reservoirs for water, hydrocarbons, and also CO₂ sequestration. Moreover, the paleontological, petrographic and geochemical interpretation of carbonate rocks and minerals contributes massively to our understanding of Earth's geologic past.

In the first part of this course, we will learn/repeat basics about the Earth's carbon cycle, the carbonic acid-carbonate system, the multitude of carbonate minerals, and get an understanding of the role of kinetics and thermodynamics in controlling carbonate geochemistry. Furthermore, we will obtain a basic understanding of how carbon and oxygen isotopes of carbonates can be used to reconstruct the environmental conditions of carbonate formation, and gain insights on why some carbonates are more pure than others when it comes to their trace constituents.

In the second part of this course, we will apply our acquired knowledge to the study of selected examples from the literature.

REQUIRED TEXTBOOK

Journal articles and review papers will be discussed throughout the course.

RECOMMENDED READING

Krauskopf K.B. and Bird D.K.: *Introduction to Geochemistry, third edition*. McGraw-Hill 1976

Morse J.W. and Mackenzie F.T.: *Geochemistry of Sedimentary Carbonates*. Elsevier 1990

Both books are available at the office of B. Brunner

COURSE OBJECTIVES

- 1) Learn the fundamentals of Earth's carbon cycle
- 2) Acquire a basic understanding of carbonate chemistry
- 3) Gain insight into how the interplay of thermodynamics and kinetics affects the geochemistry of carbonates.
- 4) Learn how carbon and oxygen isotopes can be used to interpret the genesis of carbonates.
- 5) Apply the learned concepts to examples from the literature (*potential themes* – but there are many more: Trace ions in carbonates – what they tell us, Aragonite vs. Calcite seas, the Dolomite Problem, Carbonatites, Pedogenic Carbonates, Carbon isotope fever curves)

PARTICIPATION IS ESSENTIAL (SEE GRADES)

Please contact Dr. Brunner about any concerns, schedule conflicts, etc. in advance or otherwise as soon as possible! A significant portion of your grade is based on participation, so any missed classes and assignments must have proper documentation or your grade will drop. Valid excuses include illness, absence with the instructor's prior approval, official University business, etc.

Accommodations are possible for active duty military and others, but arrangements must be made in a timely manner. If you are in the military with the potential of being called to military service and /or training during the course of the semester, you are encouraged to contact the instructor as soon as possible.

If you think you may have a disability or if you are experiencing learning difficulties, please contact the Disabled Student Services Office (DSSO) at (915) 747-5148. They are located in Union East room 106 or you can reach them by email at dss@utep.edu. The student is responsible for presenting to the instructor any DSS accommodation letters and instructions.

SCHEDULE OF TOPICS – *subject to change!*

Date:	Topic:	Reading
Week 1-7	Part 1. Introduction to Carbonate Chemistry	
Week 1	<ul style="list-style-type: none"> • Carbonates and you? Introduction of participants, discussion of syllabus and course evaluation. • Overview: what carbonate rocks and minerals are out there? 	
Week 2	<ul style="list-style-type: none"> • A cross-country race through Earth's carbon cycle, the carbonic acid system, chemical reactions, pH, Alkalinity, thermodynamics and kinetics: <i>into the Cacao!</i> • Evaluation of to-be-selected topics/examples with course participants 	Handouts
Week 3	Quiz I <ul style="list-style-type: none"> • A cross-country race through Earth's carbon cycle, the carbonic acid system, chemical reactions, pH, Alkalinity, thermodynamics and kinetics: <i>adding salt & acid to the cocktail.</i> • Evaluation of to-be-selected topics/examples with course participants 	Handouts
Week 4	Quiz II <ul style="list-style-type: none"> • From the cross-country race into the absolute wilderness: Carbon and oxygen isotopes – a crash-course: <i>the chocolate side of life.</i> 	Handouts
Week 5	Quiz III <ul style="list-style-type: none"> • From the cross-country race into the absolute wilderness: Carbon and oxygen isotopes – a crash-course: <i>clumping things together.</i> 	Handouts
Week 6	Quiz IV. <ul style="list-style-type: none"> • Introduction to Carbonate Chemistry Review I: <i>Cleaning up the mess.</i> • Selection of topics/examples by course participants 	Handouts
Week 7	Quiz V <ul style="list-style-type: none"> • Introduction to Carbonate Chemistry Review II: <i>Cleaning up the mess.</i> • Selection of topics/examples by course participants 	Handouts

Week 8-16	Part 2.	
Week 8	<i>Selected topic:</i> Selenium in Carbonates	B. Brunner
Week 9	<i>Selected topic:</i>	<i>Student 1</i>
Week 10	<i>Carbon dreams</i>	<i>Team-study</i>
Week 11	<i>Selected topic:</i>	<i>Student 2</i>
Week 12	<i>Selected topic:</i>	<i>Student 3</i>
Week 13	<i>Selected topic:</i>	<i>Student 4</i>
Week 14	<i>Selected topic:</i>	<i>Student 5</i>
Week 15	<i>Selected topic:</i>	<i>Student 6</i>
Week 16	Course review	

Grades: Quiz & Carbon dreams (30%), Participation in discussion (30%), Project presentation and handout (40%)