OCN / ERTH 644 – Sediment Geochemistry (3 credits) – Spring 2021

Course instructor: Kathleen Ruttenberg
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Office Hours: by appointment (via Zoom)
Class will be offered on-line, via Zoom: Tu & Th (12:00-1:15 pm)

Course description
This course will introduce students to the diverse nature of marine sediments, the processes by which sediments are delivered to the oceans and accumulate on the seabed, and the physical and biogeochemical processes that dictate the nature and distribution of seabed sediments in the world's oceans. A substantial focus will be on the early diagenesis of marine sediments, including qualitative and quantitative treatment of diffusion and adsorption of dissolved species; organic matter lability, decomposition, and storage; authigenic mineral formation; bioturbation and physical transport mechanisms. The principles and concepts developed in the first part of the course will be used to examine a variety of specific marine sedimentary environments, including estuarine, lagoonal, deltaic, and deeper water environments. Final lectures of the course will focus on the role of sediments in the global cycle of selected elements, including carbon, phosphorus, nitrogen and iron.

The course includes a lecture that meets 2x/week via Zoom. Twice during the semester, students will work in small groups to prepare presentation of two papers from the peer-reviewed scientific literature that advocate opposing explanations/hypotheses to explain the same phenomenon in sediment geochemistry (see more detailed description, and expectations, below). Topics for these debate style presentations, termed 'mini-lectures', are TBA; suggestions from students are welcome. There will be a mid-term and a final exam.

Prerequisites
Students are expected to have a solid background in mathematics and in chemistry (acid-base chemistry, redox chemistry, thermodynamics, chemical equilibria), and have taken OCN 623 (Chemical Oceanography) or a similar marine chemistry/geochemistry course; consent from instructor must be secured if prerequisites are not met.

Student learning outcomes
Upon successful completion of the course, students will be able to:

1. describe the nature and distribution of sediments in the world's oceans, identify sediment sources and biogeochemical characteristics
2. specify the various diagenetic processes that occur in marine sediments, and understand how to quantify these processes
3. understand the areas in which our knowledge about sediment geochemical processes is incomplete, and new methods and approaches being brought to bear to expand our ability to describe and quantify these processes
4. understand the role of sediment geochemistry in global element cycles
5. use written and oral comminication to clearly explain sediment biogeochemical processes and related contemporary research

Grading

• mid-term exam	25%
• final exam	30%
• Homework and in class assignments (includes mini-lectures)	35%
• Participation	10%

Materials

- Required textbook: ***Geochemistry of Marine Sediments***, by David J. Burdige, Princeton University Press 2006
- Scientific journal articles: **TBA**
- Other references of interest:
  Early Diagenesis: A Theoretical Approach by Robert A. Berner, Princeton University Press 1980.
  Advances in Marine Biology vol. 48: Aquatic Geomicrobiology by DE Canfield, B Thamdrup, and E Kristensen, Elsevier Academic Press, 2005.
  Aquatic Chemistry: Chemical equilibria and rates in natural waters by W Stumm and JJ Morgan (3rd edition), John Wiley & Sons, Inc., 1996.

Mini-Lectures

Overall objective: Students will summarize (in writing) and convey (orally using power point presentation) the argument developed in a chosen (hopefully controversial) paper, including evaluation of the pros/cons of the approach, and the strengths/weaknesses of the argument(s). Once two opposing papers have been presented, class will evaluate the merits of the two papers through student-moderated discussion.

For each mini-lecture:

- Two published papers that argue two opposing viewpoints will be selected.
- Two students per paper to work as a team
- Each team will provide a write-up of main points to be distributed in class meeting prior to their mini-lecture
- Each team will present their paper (their argument) in 25 minutes, leaving 25 minutes for class discussion
- For each 2-student team, 1 student will present the main points of the paper to the class; the second student will lead/moderate class discussion. Roles will be reversed for the 2nd mini-lecture so each student gets a chance to present and moderate discussion
- Topics TBA, possible examples include: (i) organic matter in sediments: productivity or preservation? (ii) What processes lead to departures from a strict hierarchy of oxidants in marine sediments?

You will be evaluated on:

1) Providing an accurate and complete overview of your assigned paper
   - context and significance of the study
   - introduction, study design, analytical technique, data handling components
   - results, figures, tables, authors' conclusions
   - analysis of strengths/weaknesses of conclusions
   - how novel/creative/significant are the findings?

2) Degree of preparation
- knowledge of background context, study details
- powerpoint is appropriately focused, well organized, slides are effective

3) Discussion/debate:
- debate is promoted/provoked with well thought-out questions
- ability to respond substantively and articulately to discussion points and questions raised

4) Quality of presentation skills
-speaking style, clarity, volume, cadence, timing, distracters, eye contact,

Class participation accounts for 10% of final grade

Each student will be expected to come to class prepared to comment on/debate the papers presented in the mini-lectures. Students are also encouraged to participate during regular lectures by raising questions or points of interest.