Course Syllabus, MSCI/GEOL 545

Course Description: This course will examine the geological aspects of oceanography; those pertaining to the formation of oceanic crust, the structure of ocean basins, formation and deposition of particles, and the sedimentary environment. All of these processes are related to chemical cycling in the oceans, biological activity, and physical processes, emphasizing the importance of incorporating geological oceanography into a comprehensive study of marine science.

Instructor: Dr. Howie Scher  
Email: hscher@geol.sc.edu  
PSC 519B  
Phone: 777-2410

Office hours: by appointment

Website: USC Blackboard: http://blackboard.sc.edu

Class schedule: Tuesday and Thursday mornings, 8:30-9:45 in Earth and Water Sciences, room 209

Texts:

The Ocean Basins: Their Structure and Evolution, Second Edition (Open University Oceanography) [Paperback]  


Papers from the literature, handouts, and reliable Internet sources

Available on Blackboard

Grading:  
Midterm 20%  
Final 20%  
Problem sets 20%  
Proposal/project and presentation 20%  
Participation during group presentations and class discussions 20%
Grades are awarded as straight percentages (> 90% = A, 87-89% = B+, 80-86% = B, etc.)

Attendance is MANDATORY: Following University Policy: Failure to attend class will affect your grade. For every 5 days of missed class, your final grade will be reduced by one letter.

Exams: The midterm and final will require completing quantitative problems and interpreting diagrams and maps. Both will be take home exams with at least three days given to complete the exams.

Problem sets: Problem sets will be based on material covered in class and several will involve the use of the desktop GIS interface GeoMapApp (www.geomapapp.org).

Course Outline:

Abbreviations: OB = The Ocean Basins: Their Structure and Evolution
MBC = Marine Biogeochemical Cycles
WTSW = Waves, Tides, and Shallow Water Processes

1. Plate tectonics review (OB, pages 26-28 and Wessel & Muller)
   - Isostatic compensation
   - Lithosphere and asthenosphere (A&O, pg. 61-66)
   - Paleomagnetism

   **Assignment 1 – Plate boundaries and earthquakes**

2. The Ocean Basins (OB Chapter 2)
   - Ocean provinces
     - Active vs. Passive margins
   - Deep sea canyons – conduits to the deep (Submarine canyons folder on BB)
   - The hypsometric curve
   - Mapping the deep – methods in bathymetry

   **Assignment 2 – hypsometric curve**

3. Evolution of Ocean Basins (OB Chapter 3)
   - Stages in the development of ocean basins
   - Overview of major ocean basins and their characteristics

4. Structure and formation of oceanic lithosphere (OB Chapter 3)
   - Development of a mechanism for oceanic lithosphere formation
Seismic profiles of oceanic lithosphere
  Ophiolites
Transform faults, fracture zones, and segmented spreading centers
Seamounts, ocean islands, and large igneous provinces
The age-depth relationship of oceanic lithosphere
Hydrothermal circulation in oceanic crust (OB Chapter 4)

**Assignment 3 – Age depth relationship of oceanic lithosphere**

5. Deep sea sediments
   Classification and distribution (MBC Chapter 1)
   Accumulation rates
     Linear sedimentation rates
     Constant flux proxies
     Sediment redistribution proxies
   Distribution of biogenic sediments (MBC Chapter 3)
     Siliceous sediments
     Deep sea carbonates (Broecker, 2003)

**Assignment 4 – Mapping the CCD using seafloor sediments**

6. Chemical reactions and microbial activity in deep sea sediments
   Organic matter and the diagenetic sequence (Froelich, 1979)
   Authigenesis and diagenesis
     Manganese nodules
     Gas hydrates
   The deep biosphere

**Assignment 5 – Sedimentation rates and accumulation rates**

7. Biogeochemistry of particulate matter in the ocean
   The biological pump and the two box model of the ocean (MBC Chapter 2)
     Particles and nutrients
     Particles and trace metals

8. Shallow water sedimentary environments
   Waves and tides review (WTSW Chapters 1-2)
   Sediment transport (WTSW Chapter 3)
   Sediment supply and crustal subsidence
   Estuaries (WTSW Chapter 6)
   Nepheloid layers

9. Paleoceanography
Marine sediments as a geological archive (Zachos et al., 2001)
Sea level estimates from marine sediments (Miller et al., 2011)
Carbonate accumulation
Biogenic carbonate oxygen isotopes
Passive margin sequence stratigraphy

LEARNING OUTCOMES: By the end of the semester it is anticipated that students will have acquired the following:

• An understanding of the structure, composition, and geological history of the ocean basins, their sediments and the water contained within
• Familiarity with methods used to date and correlate marine sediments
• Understanding the role of the ocean in the solid Earth cycle and climate system
• Appreciation of the role of biology in sediment diagenesis
• A working knowledge of the data visualization program GeoMapApp
• The ability to work efficiently with large datasets
• Improved oral and written communication skills
• Improved ability to work collaboratively

Collaboration: As Marine Science is an interdisciplinary course; marine scientists often work collaboratively on projects. I expect that many of you will choose to work in groups on assignments for this course. Please review the definitions below and come talk to one of us if you are unclear about how these apply to working together on projects.

University of South Carolina Honor Code

“It is the responsibility of every student at the University of South Carolina Columbia to adhere steadfastly to truthfulness and to avoid dishonesty, fraud, or deceit of any type in connection with any academic program. Any student who violates this Honor Code or who knowingly assists another to violate this Honor Code shall be subject to discipline.”

Forms of academic dishonesty:

Plagiarism: 1. The action or practice of taking someone else's work, idea, etc., and passing it off as one's own; literary theft.

Cheating: 1. To defraud; to deprive of by deceit. 2. To deceive, impose upon, trick. 3. To deal fraudulently, practice deceit.

Fabrication: 1. The use of invented information or the falsification of research or other findings.

Academic Misconduct: 1. An act that disrupts the educational process or provides a student with an academic advantage over another student.

I deal swiftly and harshly with all instances of academic dishonesty

EXPECTATIONS: PRESENTING ARTICLES FOR CLASS DISCUSSIONS
One of the requirements for this course is that you participate in a group (3-4 people) to present a topic covered in the course and lead a class discussion on the topic. The presentation will focus on a set of related articles on a particular topic. The presenting group will serve as the instructors to the class and effectively teach the topic to the class.

Each group will consult with me at least once prior to the presentation and discussion. Everyone in the group will fill out a peer evaluation form assessing the individual group members.

For presentations and discussions, I expect that:

- The group as a whole and as individuals achieves mastery of the scientific content of the articles and the relationship to the material presented in this course.

- The group will identify key parts of the reading prior to the discussion and communicate these sections to the rest of the class at least one class period prior to the discussion.

- The group will identify other sources that are relevant to the concept and reference these in the presentation (course texts, other papers, background references).

- The group will collaborate to prepare questions (3-5) about the important points of the article(s) as well as a summary of the article (ideally one page, no more than two pages). The summary can NOT be an outline of the slides from the presentation. It must be a standalone document in the form of an extended abstract. The questions and summary will be handed out to the class on the day of the presentation.

- The group will work collaboratively to prepare an oral presentation for the class with visual aids (e.g., PowerPoint). Everyone in the group will contribute to the presentation, but not everyone needs to speak. The presentation should be coherent and well organized, so that the material is clear to the class. The presentation is followed by a class discussion led by the group. Total time should be 30-35 minutes.

- Other class members should come to group presentations prepared to discuss key points raised by the presenting group. The discussion will be in the context of the course material.
EXPECTATIONS: Proposals

You are responsible for developing a proposal about some aspect of geological oceanography, not to exceed 15 pages, which includes references, figures, captions, tables, etc. This will be framed as a research proposal to investigate specific question for which you will describe specific objectives, review the scientific background, justification/rationale, proposed approach (methods), anticipated results, and their significance to the field. You are encouraged to discuss any budgetary and/or logistical constraints of your project (e.g., will you need to request 10 years of submersible time? Will you need $10K or $1000K?).

The final proposal will focus on five to seven journal articles as primary references (though you will probably use and cite many more than that number in the development and writing of your proposal).

It is expected that you develop your own proposal for this course, and cite your sources. You may not use a proposal from a previous class or your thesis proposal, but it is acceptable that the research questions be related. A useful discussion on defining and avoiding plagiarism can be found at: http://www.wpacouncil.org/node/9

You will also be responsible for reviewing at least two of your classmates’ proposals. Reviews will be graded as part of your proposal score.

Proposal dates:

January 30: Statement of topic due in writing
February 11: Outline and reference list due
March 6: First draft (typed)
April 10: Final draft

Outlines, first drafts, and reference lists are not expected to be finished documents but rather will serve as a framework for developing your finished proposal. We will schedule time to discuss your outlines and first drafts.

You will give a 15-minute presentation on your proposal topic in AGU oral session format. There will be 12 minutes for the presentation followed by 3 minutes of questions from the audience.

Undergraduates have the option of writing a research paper in lieu of a proposal, and presenting the topic in the format above.
Review Criteria for GEOL/MSCI 545 proposals

1. Does the proponent clearly state the question to be addressed and/or the hypothesis to be tested? If not, provide a suggestion for how the proponent could make the hypothesis clearer.

2. Are the specific objectives of the proposal outlined? Will the objectives allow the proponent to test the hypothesis?

3. Is the work plan well designed? Is it clear that the sampling strategy, tests, models, and/or other analytical approaches will result in data that can be used to test the hypotheses?

4. Provide your assessment of the scholarship of the review of the existing knowledge base.

5. Are there adequate resources to carry out the proposed research?

NSF Review Criteria (for your information)

All NSF proposals are evaluated through use of two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities. For example, proposals for large facility projects also might be subject to special review criteria outlined in the program solicitation.

The two merit review criteria are listed below. The criteria include considerations that help define them. These considerations are suggestions, and not all will apply to any given proposal. While proposers must address both merit review criteria, reviewers will be asked to address only those considerations that are relevant to the proposal being considered and for which the reviewer is qualified to make judgments.

What is the intellectual merit of the proposed activity?
How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of prior work.) To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

What are the broader impacts of the proposed activity?
How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

NSF staff will give careful consideration to the following in making funding decisions:
Integration of Research and Education
One of the principal strategies in support of NSF’s goals is to foster integration of research and education through the programs, projects and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students, and where all can engage in joint efforts that infuse education with the excitement of discovery and enrich research through the diversity of learning perspectives.

Integrating Diversity into NSF Programs, Projects, and Activities
Broadening opportunities and enabling the participation of all citizens, women and men, underrepresented minorities, and persons with disabilities, are essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.
NSF style proposal grading rubric

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>Unacceptable (Below Standards)</th>
<th>Acceptable (Meets Standards)</th>
<th>Good (Occasionally Exceeds)</th>
<th>Excellent (Exceeds Standards)</th>
<th>SCORE</th>
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<tr>
<td>Introduction to the problem/question</td>
<td>Does not adequately convey topic or questions. Does not convey hypotheses or objectives. Does not discuss context.</td>
<td>Introduces topic either the topic or key question(s). Conveys either hypothesis or objectives. General discussion of context.</td>
<td>Introduction of both topic and key questions; conveys hypotheses &amp; objectives. Discusses context of proposed work.</td>
<td>Strong introduction of key question(s) &amp; terms. Clearly delineates hypotheses, objectives &amp; approach. Places proposed work in appropriate context.</td>
<td>10</td>
</tr>
<tr>
<td>Focus &amp; Sequencing</td>
<td>Little evidence that material is related to proposed work or organized around hypotheses, objectives, or approach.</td>
<td>Most material related to proposed work. All material is not be organized around hypotheses, objectives, and approach.</td>
<td>All material clearly related to proposed work. Organization around hypotheses, objectives, and approach.</td>
<td>All material clearly related to proposed work. Strong, and consistent organization around hypotheses, objectives &amp; approach throughout proposal.</td>
<td>15</td>
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<tr>
<td>Scholarship &amp; prior work</td>
<td>No evidence to support understanding of prior work (poor scholarship). Does not convey how proposed work fills knowledge gap.</td>
<td>Either shows understanding of prior work or describes how work will fill a gap in knowledge.</td>
<td>Shows understanding of prior work. Describes how proposed work will fill a gap in knowledge.</td>
<td>Strong peer-reviewed research based support for proposed work. Clear description of prior work and gap in current knowledge.</td>
<td>15</td>
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<td>Work plan</td>
<td>No clear work plan, or work plan is not related to stated objectives</td>
<td>Work plan is clearly outlined or description of work to be completed is clearly related to objectives.</td>
<td>Work plan is clearly outlined and the description of work to be completed is closely linked to proposal objectives.</td>
<td>Work plan is outlined and summarized in a cohesive manner with a clear linkage to carrying out proposal objectives.</td>
<td>15</td>
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<tr>
<td>Grammar &amp; Mechanics</td>
<td>Grammatical errors or spelling &amp; punctuation substantially detract from the proposal.</td>
<td>Very few grammatical, spelling or punctuation errors interfere with reading the proposal.</td>
<td>Grammatical errors or spelling &amp; punctuation are rare and do not detract from the proposal.</td>
<td>The proposal is free of grammatical errors and spelling &amp; punctuation.</td>
<td>15</td>
</tr>
<tr>
<td>Science writing style &amp; Communication</td>
<td>Poor style detracts substantially from the paper. Word choice is informal in tone. Writing is choppy, with many awkward or unclear passages.</td>
<td>Poor style is noticeable. Word choice occasionally informal in tone. Writing has a few awkward or unclear passages.</td>
<td>Style does not detract from the paper. Scholarly style. Writing has minimal awkward or unclear passages.</td>
<td>Scholarly style. Writing is flowing and easy to follow.</td>
<td>20</td>
</tr>
<tr>
<td>Citations &amp; References</td>
<td>Reference and citation errors detract significantly from paper.</td>
<td>Two references or citations missing or incorrectly written.</td>
<td>One reference of citations missing or incorrectly written.</td>
<td>All references and citations are correctly written and present.</td>
<td>10</td>
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Comments:

Research paper grading rubric, H. Scher, 2013