

GEOL 565 – PALEOCEANOGRAPHY – Spring 2026
Department of Atmospheric, Oceanic, and Earth Sciences
George Mason University
January 20, 2026

PALEOCEANOGRAPHY – Investigation of ocean evolution through geologic time. Earth's ocean sediment archive provides proxy data on paleo-ocean temperature, chemistry, biology and geology. Paleo-oceanic conditions reconstructed from proxy data are examined, e.g., circulation, salinity, stratification, anoxia, and biogeochemistry. Evolution of the oceans from Precambrian to Recent is discussed. (3 credits)

BASIC INFORMATION:

Instructor: Linda Hinnov, Dept. AOES, email: lhinnov@gmu.edu

Class Meetings: Tuesdays, Thursdays, 13.30-14.45, 121 Research Hall.

Materials: Online resources, review and research articles (provided in Canvas). (*No single textbook.*)

Requirements: 8 assignments (100 points each) plus independent research project (200 points) (details below **CLASS SCHEDULE**); regular grading A-F scale.

Ethics: See <https://oai.gmu.edu/mason-honor-code/full-honor-code-document/> for course policy.

CLASS SCHEDULE:

WEEK 1: OCEAN PHYSICS AND CHEMISTRY

Tues 20 Jan – Lecture 1a: Physics - Bathymetry, temperature, density, circulation, Coriolis force; Ekman transport
Thur 22 Jan – Lecture 1b: Chemistry - Major ions, chemical divides, ocean water CO₂, carbonate equilibria

Assignment 1: Modern ocean T,S p; mineral saturation states; residence times

WEEK 2: OCEAN BIOLOGY AND SEDIMENTOLOGY

Tues 27 Jan – Lecture 2a: Biology - Productivity, decomposition, Redfield ratios, biological pump
Thur 29 Jan – Lecture 2b: Sedimentology - Coast to deep-ocean; terrigenous, marine sediment

Assignment 2: Global distribution of O₂, nutrients; Redfield ratio at Hawaii; stratigraphic logging

WEEK 3: PALEO-OCEAN TEMPERATURE AND SALINITY PROXIES

Tues 03 Feb – Lecture 3a: Paleotemperature - Oxygen isotopes, Mg/Ca, alkenones, clumped isotopes; biota
Thur 05 Feb – Lecture 3b: Paleosalinity - B/Ga, Sr/Ba, S/TOC, Na/Ca; biota

Assignment 3: Paleoecological transfer functions

WEEK 4: PALEO-OCEAN VOLUME AND SEA-LEVEL PROXIES

Tues 10 Feb – Lecture 4a: Paleo-ocean volume - Oxygen isotopes
Thur 12 Feb – Lecture 4b: Paleo-bathymetry - Sedimentary facies, backstripping

Assignment 4: Backstripping for paleo-sea-level

WEEK 5: PALEO-OCEAN CIRCULATION AND OXYGENATION PROXIES

Tues 17 Feb – Lecture 5a: Chlorinity, carbon isotopes, Cd/Ca
Thur 19 Feb – Lecture 5b: Uranium isotopes, sulfur, iron

Assignment 5: Modeling ocean anoxia with U isotopes

WEEK 6: HOLOCENE-LATE PLEISTOCENE OCEANS

Tues 24 Feb – Lecture 6a: Holocene oceans; Termination I
Thur 26 Feb – Lecture 6b: Last Glacial Cycle and the Last Glacial Maximum

Assignment 6: Calibrating O isotopes to sea-level

WEEK 7: QUATERNARY OCEANS

Tues 03 Mar – Lecture 7a: Marine Isotope Stage (MIS) evolution; Terminations

Thur 05 Mar – Lecture 7b: Milankovitch, Croll, and La Place oceans

Assignment 7: Astronomical forcing of the Atlantic and Pacific oceans, 0-2.6 Ma

SPRING BREAK

WEEK 8: CENOZOIC OCEAN EVOLUTION

Tues 17 Mar – Lecture 8a: Paleocene-Eocene Thermal Maximum, global hyperthermals

Thur 19 Mar – Lecture 8b: Gateways, global cooling, warming interludes, unipolar to bipolar glaciation

Assignment 8: Carbon and oxygen isotope evolution of the global Cenozoic ocean

WEEK 9: MESOZOIC OCEANS

Tues 24 Mar – Lecture 9a: Early Mesozoic Era (Triassic, Jurassic)

Thur 26 Mar – Lecture 9b: Late Mesozoic Era (Cretaceous)

WEEK 10: PALEOZOIC OCEANS

Tues 31 Mar – Lecture 10a: Early Paleozoic Era (Cambrian, Ordovician, Silurian)

Thur 02 Apr – Lecture 10b: Late Paleozoic Era (Devonian, Carboniferous, Permian)

WEEK 11: PROTEROZOIC OCEANS

Tues 07 Apr – Lecture 11a: Paleoproterozoic and Mesoproterozoic eras (Siderian, Rhyacian, Orosirian, Stacherian, Calymmian, Ectasian, Stenian)

Thur 09 Apr – Lecture 11b: Neoproterozoic Era (Tonian, Crogenian, Ediacaran)

WEEK 12: ARCHEAN OCEANS

Tues 14 Apr – Lecture 12a: Eoarchean and Paleoarchean eras

Thur 16 Apr – Lecture 12b: Mesoarchean and Neoarchean eras

WEEK 13: HADEAN OCEANS

Tues 21 Apr – Lecture 13a: The Hadean Eon

Thur 23 Apr – Lecture 13b: Origin of Earth's water; primordial ocean

WEEK 14: WRAP-UP; STUDENT PRESENTATIONS

Tues 28 Apr – Lecture 14a: Course wrap-up

Thur 30 Apr – Lecture 14b: Student presentations

INDEPENDENT RESEARCH PROJECT:

A written 10-page+ research paper, pre-approved by the instructor, on a topic of the student's choosing, with an oral presentation to the class at the end of the semester.

AI GUIDELINES:

AI is not required or encouraged in this course. However, AI may be consulted for collecting and organizing facts, and for suggesting hierarchical associations among facts. Otherwise, AI is intellectually risky, and must not be used to generate narratives, text, answers to questions, or solutions to problems. Use of AI must be disclosed in student assignments and research projects. Read the university's policy on AI here:

<https://www.gmu.edu/ai-guidelines>

<https://www.gmu.edu/ai-guidelines/ai-guidelines-students>

LEARNING OBJECTIVES:

Knowledge and Understanding

- Gain knowledge about ocean physics, chemistry, biology, and geology
- Gain knowledge about geological proxies and their application in reconstructing past oceans
- Understand the basic history of ocean basins, and their chemical and biological evolution

Analytical Skills and Abilities

- Develop ability to access reliable information about paleoceanography

- Develop skills for solving quantitative problems in paleoceanography with models and proxy data

Professional Development

- Communicate effectively about ocean evolution through geologic time and key events
- Learn how to stay informed about ongoing/new discoveries in paleoceanography

ADDITIONAL INFORMATION:

Disability Services at George Mason University is committed to upholding the letter and spirit of the laws that ensure equal treatment of people with disabilities. Under the administration of University Life, Disability Services implements and coordinates reasonable accommodations and disability-related services that afford equal access to university programs and activities. Students can begin the registration process with Disability Services at any time during their enrollment at George Mason University. If you are seeking accommodations, please visit <https://ds.gmu.edu/> for detailed information about the Disability Services registration process. Disability Services is located in Student Union Building I (SUB I), Suite 2500. Email: ods@gmu.edu | Phone: (703) 993-2474.