

Paleoceanography and Paleoclimatology-1 (PP-1) (first level, 15 hp, GG50113)

Course director: Helen Coxall

Course description

General description

The thick layers of sediment preserved on the seafloor provide the best means for exploring ocean and climate change in the geological past. The aim of this course is to provide you with an introduction to the geological history of Earth's ocean-climate system, focusing on ocean and climate variability and patterns and mechanisms of change over the past 65 million years as revealed by these ocean sediments. To start, you will develop knowledge of how the ocean and climate systems operate and interact during present times. Next we explore how physical, chemical and biological aspects of these systems leave characteristic imprints in marine sediments, and the methods available to extract and 'read' these clues. Throughout we will explore different climatic regimes in the past, including past greenhouse periods, examples of rapid climatic perturbations and transitions to cooler climates. These provide insights in the range of climatic variability possible on Earth and what we might expect in the future. Lectures will be underpinned by required-readings, problem-sets and practical activities (including a field excursion to a deep-sea core repository in Bremen, Germany), upon which seminar and group discussions will be based. It is essential that you read and analyze course literature and complete/prepare for the set exercises prior to meetings as requested. You should give high priority to attending all scheduled sessions, including laboratory classes and the field excursion. Over the course you will develop your expertise by identifying an appropriate deep-sea sedimentary drilling target in the Atlantic, Arctic or Mediterranean Oceans/Sea using on-line resources. This will become the focus of an ocean-climatic case-study that you will explore and develop over the 10 weeks using: (i) the relevant peer-reviewed scientific literature and (ii) observations and original analysis associated with the Bremen field trip.

Course content

The following topics will be studied:

- Paleooceanography and paleoclimatology; development of the field, key principals and role in understanding the long-term climate variability.
- Geological aspects; plate tectonics, paleogeography, evolution of the ocean basins.
- The modern ocean-climate system; ocean/atmosphere circulation, the hydrosphere & cryosphere, oceanic & atmospheric biogeochemical cycling.
- Deep-sea ocean-climate archives: types of marine sediment and controls on their distribution; stratigraphic correlation, timescales, sedimentation rates.
- Analytical methods: the paleoceanographers 'tool-kit' of physical, biological and geochemical indicators (proxies).
- Application and interpretation: Cenozoic Ocean climate-history and case studies.

Intended Learning Outcomes (ILOs)

Upon completion of this course you are expected to be able to:

1. *Identify and describe* ocean climate processes that operate on thousands to multi million - year time scales (orbital to tectonic time scales).
2. *Classify and explain* the distribution patterns and composition of seafloor sediments and *relate* these to geological and ocean climate processes.

3. *Select* geologic age- and material-*appropriate* dating and analytical methods for reconstructing ocean climate parameters from deep-sea sediments.
4. *Critically evaluate* and *synthesize* analytical records and *relate* to hypothesis about trends in paleogeography and paleoclimate over the past 150 million years.
5. *Reflect* on the implications of the observed natural variability in climate and *hypothesize* on the *value* of paleo- data for *predicting* future climate behavior.

Teaching and learning activities

The course will consist of lectures, seminars and practical activities that support active learning, including problem based learning, and are aligned with the Intended Learning Outcomes (ILO's). As a participant you will be expected to be involved with the following:

- Seminars, lectures, practical laboratory exercises and small group activities facilitated by the course leaders.
- Peer feedback. How are your course mates doing? What can you learn from them?
- Course-long deep-sea drilling focused 'Core- Assignment', providing 'quazi-real' execution of academic concepts.
- Excursion to the International Ocean Discovery Program Core Repository in Bremen, Germany (three days, costs are partly paid by the students).
- Individual work consisting of reading, report writing and power point presentations.

Course requirements

In order to pass this course and gain the 15 hp credits you must fulfill the following course requirements:

	Contribution (%)	Course requirement
Seminars & group activities, Set exercises	N/A	Participate in all group activities, including peer assessment, and complete set exercises to a satisfactory standard.
Exam	50	Achieve a minimum of an E grade (50%) in the course exam
Climate cycles exercise	N/A	This is not graded but is a compulsory part of the course.
IODP Core-Assignment (seminars & written report)	50	Identify, justify and analyze a deep-sea sedimentary drilling target in the Atlantic Ocean using on-line resources, sedimentological observations in Bremen and published scientific literature. Apply knowledge of paleoceanographic methods and hypotheses that demonstrate you have met the 5 intended learning outcomes for the course. Achieve a minimum of an E grade in the written report (50%).

Exam and report grading

90-100	A	PASS
80-89	B	PASS
70-79	C	PASS
60-69	D	PASS
50-59	E	PASS
40-49	Fx	FAIL
0-39	F	FAIL

Course literature

W.F. Ruddiman, 2013, *Earth's Climate: Past and Future*

W.H. Freeman, 3rd ed.

ISBN: 9781429255257

– **required**,

K. St John, R.M. Leckie, K. Pound, M. Jones, L. Krissek, 2012

Reconstructing Earth's Climate History: inquiry-based exercises for lab and class

John Wiley & Sons, Ltd.

ISBN 9780470658085 (hardback)

ISBN 9781118232941 (paper)

ISBN 9781119959892 (E-book)

– **recommended**

A number of the set exercises come directly from or are based on those in the St John et al. book. All the chapters and supporting information is relevant to the course. You will be provided with the question sets for each exercise, however you might like your own copy as a complete reference.

The exercises will not be graded but is essential that you complete them all (this will be checked).

Wk	Exercise	Chapter/Theme	
44	1.1	Introduction to paleoclimate records	
45	5.1-5.8	CO ₂ as a climate regulator during the Phanerozoic and today	
47	12.1	Interpreting Antarctic sediment cores: a record of dynamic Neogene climate	
47	2.1-2.4	Seafloor sediments	
47	3.1-3.5	Microfossils and biostratigraphy	
49	10	The benthic foraminiferal oxygen isotope record /EOT	
2	14.1-14.3	Northern Hemisphere Glaciation	
2	9.1	The Paleocene Eocene thermal maximum	

Other Readings

See document 'PP1 Course literature VT 2015-2015