

Metal Contaminants – Metals in the Ocean

INTERDISCIPLINARY COURSE ON HEAVY METAL CONTAMINANTS IN THE MARINE ENVIRONMENT

LEARN ABOUT

- Biogeochemical cycling of metals
- Environment management strategies, and policy
- Effects of climate change on heavy metals
- Effects of both current and future ocean activities, interventions, and solutions
- Analytical techniques
- Risk assessment, management strategies, and policy



DELIVERY:

a blend of hybrid & online lectures and hybrid applied learning exercises by international experts

DATES: 12 October- 15 December, 2026

Registration

CAU-Students via
OpenOlat
bioc385-01a Metal
Contaminants - Metals
in the Ocean,
SeaEU-Students via
QR code



SeaEU



Kiel University
Christian-Albrechts-Universität zu Kiel



SEA-EU Module description

Module offers for the 'SEA-EU Virtual Modules'

General Information

Module/Course Name	Metal Contaminants – Metals in the Ocean	
Module/Course Code	bioc385-01a	
Field of Education	Generic programmes and qualifications	☐
	Education	☐
	Arts and humanities	☐
	Social sciences, journalism and information	☐
	Business, administration and law	☐
	Natural sciences, mathematics and statistics	☒
	Information and Communication Technologies	☐
	Engineering, manufacturing and construction	☐
	Agriculture, forestry, fisheries and veterinary	☐
	Health and welfare	☐
	Services	☐
Study programme	Master of Science Biological Oceanography	
Number of ECTS and total student workload	5 ECTS, and 150 hours	
Contact hours and Independent study hours	35 contact hours and 115 hours independent study	
Typology of contact hours	Lecture, Discussion and Exercise (ca. 25 hours in class), 10 hours for recorded lectures; 115 hours self-study: reading, preparation, online self-tests, and written and oral assignment preparation.	
Academic Year	2026/27	
Semester / Specific period	Winter semester (i.e. September to January for SEA-EU)	
Teaching Language	English	
Delivery mode	This module takes place in a blended format, including self-study online lectures and on-site/ hybrid exercises. While one	

	1h lecture, followed by 1h exercise on the same topic, will take place on-site at GEOMAR and being made available for off-site students via WEBEX (i.e. hybrid), a second lecture will be provided as video recording, which can be viewed in the self-study phase. Video recorded lectures are produced solely for this module. Online discussion with lecturers is strongly encouraged. All lectures will be followed by ungraded knowledge tests. Exercises are aimed to deepen the theoretical knowledge and combine with practical application. Hybrid offer for international participation via Webex.
Responsible Lecturer	Name: Prof. Sylvia Sander E-Mail: ssander@geomar.de
Other lecturers	Invited international guest lecturers (incl. from one SEA-EU partner), providing best expertise on the topics. The list of confirmed lecturers can be found in the module plan provided.
Learning outcomes	This course provides students with a comprehensive understanding of marine metal contaminants, encompassing their chemistry, environmental toxicology, risk assessments, management, and analytical skills. By the end of the course, students will have developed an interdisciplinary understanding and practical expertise on metals in the ocean and the skills to assess and evaluate potential impacts of metal contaminants in marine environments.
Course contents	Students will study the transport, fate, and speciation of metals, alongside bioavailability, bioaccumulation, and detoxification mechanisms. The curriculum emphasises evaluating biotic responses to metal exposure, utilising biomarkers, and conducting risk assessments through environmental toxicology principles. A key focus is on the impact of current and future ocean activities, such as deep-sea mining and ocean alkalinity enhancement, on metal contamination. Students will analyse these activities' environmental implications and explore potential solutions. The course also covers the scientific, technological, societal, and economic aspects of ocean interventions, integrating natural sciences with economics, biotechnology, ethics, policy, and ocean governance. Case studies will provide practical insights into contemporary marine ecotoxicology applications. The blended course format will consist of on-site/hybrid, as well as self-study online lectures, on-site/hybrid Q&A sessions and applied learning exercises. While the

	hybrid/online lectures will be accompanied by online self-tests, the exercises will deepen the theoretical knowledge by examples of practical application. Students will read and discuss selected papers, and engage in group discussions. Each student will also identify a topic of interest and produce an essay, as well as present it to the group. The topic of the presentation may be any area of metal contaminants, a case study, or a question (e.g., impact of climate change, efficacy of ocean solutions/interventions) with an explicit link to marine metal contaminants.
Prerequisites and/or recommended academic background	None.
Assessment	Graded oral presentation (100%). Prerequisite to deliver the oral presentation is an active participation during the seminars and exercises.
Main bibliography	Relevant literature will be distributed over the course of the module.

Organisational Information

Maximum number of SEA-EU participants
15
Learning Management System
OpenOLAT
Course schedule (date and time)
In-person/hybrid live lectures & exercises on Tuesdays 15:30 - 17:30 h (CET), video recorded lectures provided each Friday, between 13 th October and 18 th December 2026.
Application deadline
04 October 2026

bioc385-01a METAL CONTAMINANTS – METALS IN THE OCEAN WS2025/27

Module Structure and dates – updated 22.07.26

Date/Format/ time (in)	Topic	Primary Lecturer/s (affiliations)
13.10. 2026 in-person for Kiel students, others hybrid @ 15:30 (note: will be recorded)	Introduction - Course organizers, lectures and participants - SEA-EU - Course structure, expectations, workload and grading	Prof. Sylvia Sander (GEOMAR & CAU) Leah Schroedter (SEA-EU)
16.10.2026 Lecture 1, online	Introduction of metals in the Ocean - Importance of metals - Natural and anthropogenic sources and sinks - Distribution	Prof. Sylvia Sander (GEOMAR & CAU)
20.10. 2026 Lecture 2 and Exercise, hybrid @ 15:30	Introduction to sample collection and analytical methods of metal contaminants in the marine environment - Trace metal clean working procedures - Trace metal clean water samplers for different environments (water column, hydrothermal fluids, pore waters) - Trace metal analysis (matrix separation, concentrations, speciation) Practical exercise: Cu analysis in marine hydrothermal samples – cruise preparation, sampling to analysis in the home lab	Dr. Sophie Paul (GEOMAR)
23.10. 2026 Lecture 3, online	Trace Metals as micro-nutrients - Metabolic roles, bioavailability, limitation/excess - Analytical methods to assess bioavailability, bioaccumulation - Biotic and ecosystem metal contaminant responses - Links to climate	Dr. Christel Hassler (EPFL, Switzerland)
27.10.2026 Lecture 4 and Exercise, hybrid @ 15:30	Analytical error and uncertainty estimation - What is measurement uncertainty estimation, why is it important - What data are needed Practical exercise: Measurement uncertainty estimation of iron content in sea-water using interactive Excel sheet	Prof. Dr. Ivo Leito (Univ Tartu, Estonia)
30.10. 2026 Lecture 5, online	Introduction to current natural and anthropogenic metal contaminant issues, e.g., - Floods, dust, volcanoes - Use of biocides in ships paint, mine tailing issues, deep-sea mining	Prof. Dr. Sylvia Sander (GEOMAR & CAU)
3.11. 2025 Lecture 6 and Exercise, hybrid @ 15:30	Ecotoxicology and deep-sea mining - Deep-sea mining impacts - The necessity of knowing the baseline - Assessment of ecotoxicological effects Practical exercise: Determine the ecological effects concentration (EC ₅₀ /LC ₅₀) of a metal contaminant causing damage to an organism	Dr. Nélia C. Mestre (Universidade do Algarve, Faro, Portugal, SEA-EU partner)
6.11.2025 Lecture 7, online	The use of isotopes for source appointment and process analysis of trace metals in the ocean (preliminary title)	Prof. Dr. Tim Conway (USF, USA)
10.11.2025 Lecture 8 and Exercise, hybrid @ 15:30	Emerging topics: From Interstellar ⁶⁰Fe to Ocean Archives: Radionuclide Applications in Geochronology, Oceanography, and Astrophysics	Dr. Dominik Koll (HZDR and ANU)
13.11.2025 Lecture 9, online	Effect of ocean solutions on metals distribution Ocean alkalinity enhancement Case study: Volcanic eruptions as a source of fertilizing and harmful metals – possible insights for ocean alkalinity enhancement research	Prof. Dr. Linn Hoffmann (University of Otago, New Zealand)
17.11. 2026 Lecture 10 and Exercise, hybrid @ 15:30	Marine Geochemical Modelling - Basics - the carbonate system - inorganic speciation of metals Hands on geochemical modelling using MARCHEMSPEC	Dr. Laura Haffert (GEOMAR)
20.11.2026 Lecture 11, online	Effect of climate change on contaminants and pollutants in the ocean with specific focus on heavy metals	Dr. Dario Omanovic (IRB, Zagreb, Croatia)
24.11. 2026 Lecture 12 and Exercise, hybrid @ 15:30	Introduction to environmental risk assessment of anthropogenic metal contaminant issues Practical exercise: Development of a monitoring plan for the diagnosis of the heavy metal contamination, development of a communication plan and presentation of small-group results.	Prof. Dr. Daniel Rosado (University of Sevilla, Spain)

27.11.2026 Lecture 13, online	Legal aspects of using the High Seas (area beyond national jurisdiction) ○ Legal frameworks of the ocean ○ The International Seabed Authority ○ BBNJ agreement	Prof. Dr. Nele Matz-Lück (CAU, Germany)
1.12.2026 Lecture 14 and Exercise, hybrid, @ 15:30	Trophic Transfer and Biogeochemistry of Mercury: Implications for Seafood Safety Practical exercise: Ways to act for global change - how can we influence policy	Dr. Michael Bank (Norwegian Institute of Marine Research, Norway)
4.12.2026 Lecture 15, online	UN Environment Program: Minamata convention and how science informs global decisions	Dr. Gamini Manuweera (Consultant, prev. UNEP, USA)
8.12.2026 Lecture 16 and Exercise, hybrid @ 15:30	Social Science Aspects and Community Science Activities: Caring for marine environments Practical exercise: How can we care for the marine environment and what can care concepts add to technology assessment practices?	Dr. Sarah Schönbauer (Technische Universität München)
11.12.2026 Hybrid @ 15:30	Preparation meeting for oral presentation to cover open questions	Prof. Dr. Sylvia Sander (GEOMAR & CAU),
15.12.2026 Exam, hybrid @ 15:30	Oral presentations by students of selected topics (graded)	Prof. Dr. Sylvia Sander (GEOMAR & CAU)
18.12.2026 Exam, hybrid @ 15:30	Oral presentations by students of selected topics (graded)	Prof. Dr. Sylvia Sander (GEOMAR & CAU)