

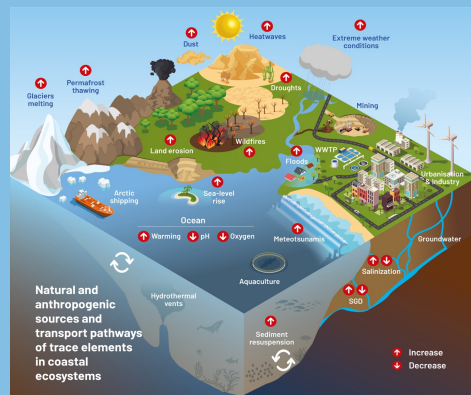
MSc MODULE

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 online lectures by international experts and hybrid applied learning seminars.

DATES: 15 October- 17 December, 2024.

Registration



CAU



SeaEU



Kiel University
Christian-Albrechts-Universität zu Kiel



Module Name	Metal Contaminants – Metals in the Ocean	
Module Number	bioc385-01a	
Person in Charge	Prof. Dr. Sylvia Sander Phone: +49-(0)431-600-1420, E-mail: ssander@geomar.de	
Semester / Duration	One semester	Status Optional
Regular Cycle	Annual in winter semester	
Study Programme	Master of Science in Biological Oceanography	
Classes	Class Title (Teaching Form) Lecturers	Contact Time / Group Size
	<u>Metal Contaminants - Metals in the Ocean</u> (Lecture hybrid) Prof. Dr. Sylvia Sander and invited international guest lecturers providing best expertise on the topics	2 hr per week / 20 students
	<u>Case studies of marine metal contaminants</u> (Seminar hybrid) Prof. Dr. Sylvia Sander and invited international scientists providing best expertise on the topics	1 hr per week / 20 students
Credit Points / Workload	5 ECTS / 150 hours	
Prerequisites	None.	
Completion Module	None.	
Following Module	None.	

<p>Educational Objectives</p>	<p>This course provides a comprehensive insight to the topic of marine metal contaminants, encompassing their chemistry, environmental toxicology, risk assessments, management, and analytical skills. 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. 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</p>
<p>Content Of Teaching</p>	<p>This blended course format will consist of self-study online lectures, in-person/hybrid Q&A sessions and applied learning seminars. While the online lectures will be accompanied by online self-tests, the seminars 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 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.</p>
<p>Examination</p>	<p>Individual oral presentation (100%)</p>
<p>Literature</p>	<p>Relevant literature will be distributed within the respective courses.</p>
<p>Additional Information</p>	<p>In the framework of the interdisciplinary Master School of Marine Sciences (iMSMS), this elective module is open to Master students of all CAU programmes. They are obliged to verify the ECTS recognition with their examination office or study program responsible. The module is also internationally offered in the framework of the SEA-EU alliance.</p>

bioc385-01a METAL CONTAMINANTS – METALS IN THE OCEAN WS2024/25 Module Structure and dates

Date	Format/date	Topic	Primary Lecturer/s (affiliations)
Week starting 14.10.2024	Lecture 1 online 14.10.2024	Introduction of metals in the Ocean <ul style="list-style-type: none"> ○ Importance of metals ○ Natural and anthropogenic sources and sinks ○ Distribution 	Prof. Sylvia Sander (GEOMAR & CAU)
	15.10. 2024 Seminar	In person meeting for Kiel students, Introductions: <ul style="list-style-type: none"> ○ participants ○ SeaEU ○ course structure, expectations, workload and grading <p>Case study on the importance, sources and sinks of trace metals: Trophic Transfer and Biogeochemistry of Mercury: Implications for Seafood Safety</p>	Prof. Sylvia Sander (GEOMAR & CAU) Leah Schroedter (SEA-EU) Dr. Franziska Werner (iMSMS, CAU)
	Lecture 2 online 16.10.2024	Sample Collection Techniques and Technologies <ul style="list-style-type: none"> ○ Trace metal clean working procedures ○ Discrete surface water samplers (SLM sampler, Niskins) ○ Discrete deep-water samplers (CTD, ROV (IGT, KIPS, Major) Bottom Water Samplers) ○ In-situ samplers ○ DGT 	Dr. Rebecca Zitoun (GEOMAR & IMOS, Australia)
Week starting, 21.10.23	Lecture 3 online 21.10.2024	Introduction to analytical methods of metal contaminants in the marine environment <ul style="list-style-type: none"> ○ Trace metal clean analysis / sample handling ○ ICP-MS ○ Voltammetry ○ DMA, etc. 	Dr. Rebecca Zitoun (GEOMAR & IMOS, Australia)
	22.10.2024 Seminar	Analytical error and uncertainty estimation	Prof. Ivo Leito (Univ Tartu, Estonia)
	Lecture 4 online 23.10.2024	Trace Metals as micro nutrients <ul style="list-style-type: none"> ○ metabolic roles ○ bioavailability, limitation/excess ○ analytical techniques/methods to asses bioavailability, bioaccumulation ○ biotic and ecosystem responses of metal contaminants in the marine environment ○ links to climate 	Dr. Christel Hassler (EPFL, Switzerland)
Week starting 28.10.24	Lecture 5 online 28.10.2024	Introduction to current natural metal contaminant issues <ul style="list-style-type: none"> ○ floods ○ dust ○ volcanoes ○ groundwater 	Prof. Sylvia Sander (GEOMAR & CAU)
	29.10.2024 Seminar	Understanding sources, sinks and roles of trace metals in the ocean through GEOTRACES Introduction to the international program and practical exercises how to use the data	Prof. Sylvia Sander (GEOMAR & CAU)
	Lecture 6 online 30.10.2024	Introduction to current anthropogenic metal contaminant issues and solutions <ul style="list-style-type: none"> ○ Plastics ○ Coastal infrastructure ○ Aquaculture ○ Use of biocides in ships paint? 	Prof. Sylvia Sander (GEOMAR & CAU)
Week starting 4.11.24	Lecture 7 online 4.11.2024	Introduction to current anthropogenic metal contaminant issues and solutions (1) <ul style="list-style-type: none"> ○ Mine tailing issues ○ Deep-sea mining 	Prof. Sylvia Sander (GEOMAR & CAU)
	5.11.2024 Seminar	Risk Assessment: Introduction to sediment quality guidelines, enrichment indices vs. toxicity indices, pseudo total heavy metal concentrations as indicators for toxicity risks in Sediments vs. labile fractions concentrations	Assoc. Prof. Daniel Rosado (University of Sevilla, Spain)

		Practical exercises: Development of a monitoring plan for the diagnosis of the heavy metal contamination, development of a communication plan and presentation of small-group results.	
	Lecture 8 online 6.11.2024	Activities on reducing metal contamination <ul style="list-style-type: none"> ○ Remediation techniques for trace metal marine contamination ○ Case Study: Seaweeds and microalgae - Promising tools for heavy metal remediation? 	Dr Jan Muschiol (<i>GEOMAR, Germany</i>)
Week starting 11.11.24	Lecture 9 online 11.11.2024	Effect of ocean solutions on metals distribution <ul style="list-style-type: none"> ○ Ocean fertilization ○ Iron fertilization Case study: Natural iron fertilization: Heard Island volcanic iron in the Southern Ocean	Dr. Thomas Holmes (<i>Institute of Marine and Antarctic Studies, Australia</i>)
	12.11.2024 Seminar	Practical exercises on remediation and ocean solutions	Dr Jan Muschiol (<i>GEOMAR, Germany</i>) und Prof. Sylvia Sander (<i>GEOMAR & CAU</i>)
	Lecture 10 online 13.11.2024	Effect of ocean solutions on metals distribution <ul style="list-style-type: none"> ○ Ocean alkalinity enhancement ○ Case study: Volcanic eruptions as a source of fertilizing and harmful metals – possible insights for ocean alkalinity enhancement research 	Assoc. Prof Linn Hoffmann (<i>University of Otago, New Zealand</i>)
Week starting 18.11.24	Lecture 11 online 18.11.2024	Marine Geochemical Modelling <ul style="list-style-type: none"> ○ Basics ○ the carbonate system ○ inorganic speciation of metals ○ organic speciation of metals 	Dr. Laura Haffert (<i>GEOMAR</i>)
	19.11.2024 Seminar	Hands on geochemical modelling using MARCHEMSPEC	Dr. Laura Haffert (<i>GEOMAR</i>)
	Lecture 12 online 20.11.2024	Effect of climate change on contaminants and pollutants in the ocean with specific focus on heavy metals	Dr. Dario Omanovic (<i>IRB, Zagreb</i>)
Week starting 25.11.24	Lecture 13 online 25.11.2024	Legal aspects of using the High Seas (area beyond national jurisdiction) <ul style="list-style-type: none"> ○ Legal frameworks of the ocean ○ The International Seabed Authority 	Prof Nele Matz-Lück (<i>CAU, Germany</i>)
	26.11.2024 Seminar	Panel discussion: Ways to take action for global change: how can we influence policy	Prof. Sylvia Sander (<i>GEOMAR & CAU</i>), Rebecca Zitoun (<i>GEOMAR & IMOS, Australia</i>), and experts from NGOs , and international advisory bodies
	Lecture 14 online 27.11.2024	UN Environment Program: Minamata convention and how science informs global decisions	Gamini Manuweera (<i>Consultant, prev. UNEP, USA</i>)
Week starting 2.12.24	Lecture 15 online 2.12.2024	Social Science Aspects and Community Science Activities	Primary Lecturer: tbc
	3.12.2024 Seminar	Preparation meeting for oral presentation – obligatory attendance! and How you, as a student can get involved in global environmental science Example: Mercury in sediments of the Rio Magdalena River, Columbia	Prof. Sylvia Sander (<i>GEOMAR & CAU</i>), And Omar Keshk (MSc student MMR and participant 2023)
Week starting 9.12.24	10.12.24 Seminar	Oral presentations by students of selected topics (graded)	Prof. Sylvia Sander (<i>GEOMAR & CAU</i>), Rebecca Zitoun (<i>GEOMAR & IMOS, Australia</i>)
Week starting 16.12.24	17.12.24 Seminar	Oral presentations by students of selected topics (graded)	Prof. Sylvia Sander (<i>GEOMAR & CAU</i>), Rebecca Zitoun (<i>GEOMAR & IMOS, Australia</i>)