Activity Reports by Graduate Students Participating in KM26-08 Oceanographic Research Cruise

Students affiliated with WPI-AIMEC and the JST-ASPIRE project participated in the KM26-08 oceanographic research cruise, conducted as part of the JST-ASPIRE project, aboard the JAMSTEC research vessel KAIMEI in the northwestern Pacific Ocean from August 24 to September 4.

During the cruise, students gained hands-on experience in oceanographic research, contributing to sample collection and onboard scientific operations. For many, this was their first opportunity to take part in a research cruise. The participant reports also include two recent graduates, who joined the expedition in technical support roles. Below, they share highlights from their research activities and onboard experiences. Entries are listed in alphabetical order.

Name and Affiliation

Lukas Dirksen, Research Technician, MARUM Center for Marine Environmental Sciences, University of Bremen

Research Activities

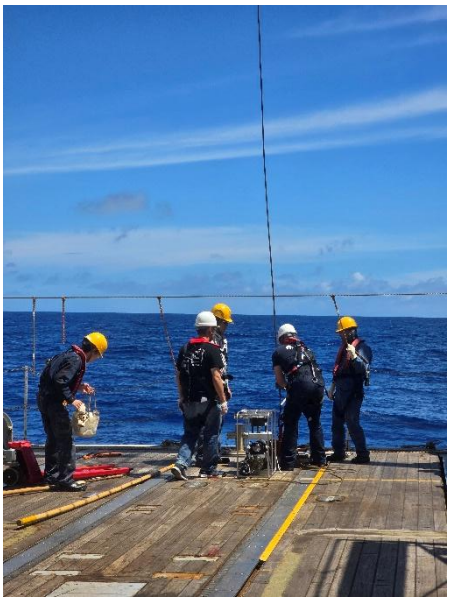
Dirksen joined the expedition in a technical support role, to collect and process samples for the Organic Geochemistry Group (AG Hinrichs) at MARUM.

During the cruise, he helped deploy, program, maintain, and recover in situ pumps, coordinated sampling operations, and processed sediment cores recovered using a Multiple Corer (MUC). This included core sectioning and porewater extraction for future analyses of dissolved inorganic carbon, nutrients, and elemental concentrations. Following the cruise, he will continue supporting sample analysis using HPLC-MS systems to identify and measure organic compounds and help optimize analytical results.

Onboard Experience

Dirksen described the cruise as a "*complete success*" noting that the team collected more samples than originally planned. He praised the support of the science team and crew that enabled successful operations despite language barriers. Looking ahead, he is enthusiastic about future collaboration, noting that "*the possibilities for cooperation seem endless*." Dirksen expressed gratitude for the opportunity and hopes to further strengthen cooperation and scientific exchange among the participating institutions.

Collected seafloor sediment JAMSTEC ©



An *in-situ* pump, brought from MARUM Center for Marine Environmental Sciences, University of Bremen, is deployed from research vessel *KAIMEI* for particulate organic matter sampling. JAMSTEC ©

Name and Affiliation

Monami Mutoh, Department of Earth Science, Graduate School of Science, Tohoku University

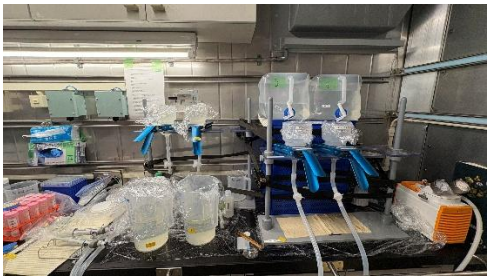
Onboard Research Activities

Mutoh joined the cruise to collect seawater samples for neodymium (Nd) isotope analysis and gain experience oceanographic observation and analytical techniques. During Conductivity, Temperature, and Depth (CTD) observations near the Kuroshio Extension Observatory (KEO), she collected and processed seawater samples for several geochemical analyses, including Nd isotopes. This involved concentrating dissolved Nd from seawater using an iron hydroxide [$Fe(OH)_3$] coprecipitation method for later lab analysis.

She also participated in sediment sampling using a Multiple Corer (MUC), including sediment core description, porewater collection, and sediment sectioning, and assisted with environmental DNA (eDNA) sampling. The samples collected will help characterize Nd isotope signatures in modern water masses and provide reference data for interpreting palaeoceanographic records preserved in fossil foraminifera.

Onboard Experience

Mutoh described the cruise as an "*extremely valuable and enjoyable experience*" and appreciated that "*students were treated as members of the research team*." Discussions with scientists from diverse fields, both during laboratory work and informal moments, helped her view her research from new perspectives. She reflected that "*the cruise was both scientifically productive and personally inspiring*" and expressed her gratitude to everyone for their support.



Porewater collection from sediment cores recovered from the seafloor using a Multiple Corer. JAMSTEC ©

WPI-AIMEC Researcher Hideko Takayanagi (Associate Professor, Tohoku University) and Tohoku University graduate students Teja Machhindra Pawase and Monami Mutoh conducted experiments onboard KAIMEI. JAMSTEC ©

Name and Affiliation

Yuki Nishioka, Graduate School of Engineering, Tohoku University

Onboard Research Activities

Nishioka's main objective during the cruise was to investigate organic matter in the deep ocean and near the seafloor and understand how it changes as it sinks from the ocean surface to the deep sea. Seawater samples were collected from multiple depths near the KEO using a CTD sampling system and sediment core samples using a MUC. By analyzing these samples, he will examine how organic matter changes with depth and characterize the organic matter preserved in seafloor sediments. These findings may help improve understanding of the processes that control organic matter decomposition and oxygen consumption in the bottom layer of coastal bays where aquaculture is practiced.

Onboard Experience

As a first-time research cruise participant, Nishioka found the work onboard *"challenging in ways that differed from my usual research conducted on land"*. His research usually focuses on coastal bays where aquaculture is practiced, but this experience sparked his interest in the open ocean and material cycling. He commented that despite his limited experience with research cruises, he received great support and open communication from fellow participants throughout the voyage.

Name and Affiliation

Ken Oso, Graduate School of Engineering, Tohoku University

Onboard Research Activities

Oso's goal was to collect seawater, seafloor sediment, and zooplankton samples to better understand deep-sea ecosystems and learn contamination-prevention techniques for handling samples containing very low concentrations of organic matter. Seawater was collected from multiple depths using a CTD sampling system, sediment cores using a MUC, and zooplankton using a Vertical Multiple Plankton Sampler (VMPS). He will analyze these samples to investigate the composition and origins of organic matter in the deep ocean and seafloor sediments. He also plans to examine the fatty acid composition of zooplankton to better understand feeding relationships and food web structure in deep-sea ecosystems. In addition to his own research, he assisted with routine sampling operations, sample processing, and plankton handling onboard.

Onboard Experience

Reflecting on the cruise, Oso noted that the short breaks between operations, the need to follow carefully coordinated workflows, and the repetitive nature of many tasks highlighted the importance of effective time management and teamwork. In addition to routine sampling activities, he participated in a variety of onboard operations, including equipment leak checks, which provided valuable insight into how research cruises are conducted. He described the experience as “*extremely educational*” and expressed his gratitude to everyone onboard who supported him.

Name and Affiliation

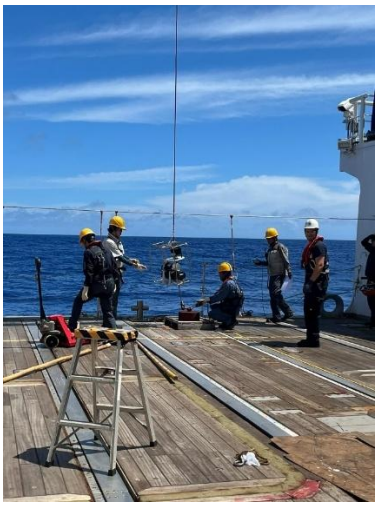
Julia Pamphile dos Santos, MARUM Center for Marine Environmental Sciences, University of Bremen, Bremen, Germany.

Onboard Research Activities

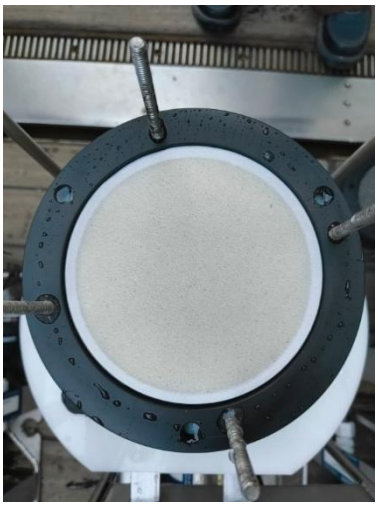
Pamphile dos Santos joined the cruise to investigate how organic matter is transformed, degraded and preserved as it sinks from the ocean surface to the seafloor and better understand why some carbon is stored in the deep ocean while some is broken down by microorganisms. To address these questions, she collected seawater, particulate organic matter (POM) and seafloor sediment samples using a range of oceanographic sampling systems, including CTD casts, a Marine Snow Catcher and *in-situ* pumps. She conducted incubation experiments to study how microorganisms consume different types of organic matter in the ocean. By comparing their activity at different depths, she hopes to better understand the role microbes play in breaking down and recycling carbon as it moves through the ocean.

Onboard Experience

Pamphile dos Santos commented on the great array of different research instruments available on the research vessel which makes it possible to get a good overview of the physical and biogeochemical processes that shape the environment. She found the other researchers to enthusiastic and very open to discussions and their projects and ideas. "*This cruise was an amazing professional experience*".



An *in-situ* pump, brought from MARUM Center for Marine Environmental Sciences, University of Bremen, is deployed from research vessel *KAIMEI* for particulate organic matter sampling. JAMSTEC ©



A Glass Fiber Filter used to collect particulate organic matter (POM), i.e. solid debris of marine life often known as "marine snow", from seawater samples. JAMSTEC©

Name and Affiliation

Tejaswini Machhindra Pawase, Department of Earth Science, Graduate School of Science, Tohoku University

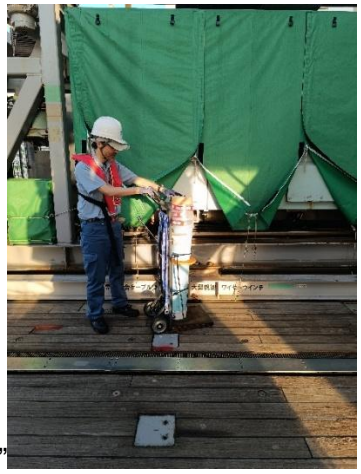
Onboard Research Activities

Pawase used seawater samples collected from multiple sites and depths south of the Kuroshio Extension to carry out a range of geochemical analyses, including oxygen, carbon, neodymium and barium isotopes. By examining these measurements, she aims to better understand how the properties of different water masses vary throughout the region.

Her research focuses on proxy data assimilation, an approach that combines evidence from natural archives of past environments with computer models to reconstruct past ocean conditions. Because this work relies on both modern observations and palaeoceanographic records, participating in the cruise provided valuable insight into how oceanographic data are collected, processed and analyzed. Gaining firsthand experience with seawater isotope sampling and analysis will help her better evaluate and interpret the model results used in her research.

Onboard Experience

Pawase found that interacting with researchers from diverse fields broadened her perspective on how seawater and sediment samples can be used. Learning about microplastics, eDNA sampling, flow cytometry and next-generation Argo floats exposed her to new research areas beyond her own field. She noted that she received *“brilliant guidance on the cruise to understand how oceanographic data is collected and processed”*.



WPI-AIMEC Principal Investigator Shinya Kouketsu (Professor, Tohoku University and Senior Researcher JAMSTEC) examines the recovered Argo float. JAMSTEC ©

Filtration system to process seawater samples collected during CTD observations for biogeochemical and isotope analyses. JAMSTEC ©

Name and Affiliation

Kaito Shin, Graduate School of Life Sciences, Tohoku University

Onboard Research Activities

Shin’s objectives were to collect eDNA samples for sea surface water along Kuroshio current and to learn practical methods for conducting marine surveys. Extensive eDNA sampling of surface and deep waters was conducted to investigate how fish communities vary across locations and depths. Surface-water samples were collected continuously at 15-minute intervals along the survey route, while deep-water samples were collected using a CTD system. The collected water samples have been filtered and the DNA they contain will be analyzed to identify fish species they contain.

These results will be combined with other observational data to understand how fish communities change horizontally and vertically and identify the factors driving these changes. Because many aspects of open-ocean ecosystems remain poorly understood, Shin hopes to explore whether vessel-based water sampling can provide an effective way to study them.

Onboard Experience

Beyond his eDNA research, Shin gained hands-on operational experience assisting with equipment like CTD systems and the Vertical Multiple Plankton Sampler (VMPS). He particularly valued the interdisciplinary, international exchange onboard, noting "it is rare to see (other researchers') sampling activities up close at sea." Deeply grateful to the team for his first cruise, Shin is eager to return to sea on future expeditions.

Views of the northwestern Pacific Ocean during the KM26-08 research cruise aboard KAIMEI. JAMSTEC ©

Name and Affiliation

Chloe Tan, Research Technician, Graduate School of Agricultural Science, Tohoku University

Onboard Research Activities

Tan's main objective for the research expedition was to collect eDNA samples from different ocean depths and investigate marine biodiversity in the Northwestern Pacific. This was done by attaching sampling devices to several research platforms operated during the cruise, including a CTD system, Multiple Opening/Closing Net and Environmental Sensing System (MOCNESS), MUC, *in-situ* pumps and VMPS. This enabled sample collection from waters ranging from approximately 10 m to 6,000 m depth, with particularly intensive sampling in the upper 200 m.

Onboard, DNA was extracted from approximately 60 samples, including replicates. These samples will undergo Nanopore metabarcoding, a technique that identifies organisms from their DNA, allowing biodiversity to be compared across different depths and ocean environments.

Onboard Experience

Tan commented that the onboard activities helped create valuable opportunities for future interdisciplinary collaboration.

Name and Affiliation

Chanikarn Yongstar, Graduate School of Agricultural Science, Tohoku University

Onboard Research Activities

Yongstar participated in the research cruise to evaluate a passive eDNA sampling method in the open ocean. By attaching devices to oceanographic equipment deployed at various depths, she collected eDNA throughout the water column without needing large-volume seawater samples. To determine which organisms are present at each depth, samples will be analyzed using multiple genetic markers and Oxford Nanopore sequencing. Drawing on her experience in molecular and computational analysis, Yongstar will perform the sequencing and subsequent bioinformatics data analysis to characterize the detected biological communities.

Onboard Experience

The cruise gave Yongstar a valuable opportunity to see how multi-instrument research is carried out at sea. She noted that it made her think about how eDNA can be integrated with other oceanographic observations and physical data like depth, temperature and salinity to map ocean biodiversity. Working alongside researchers from different fields also gave her a much better appreciation for the teamwork required in shipboard research; “*the cruise gave me both new scientific ideas and a much better appreciation of collaborative ocean research*”.