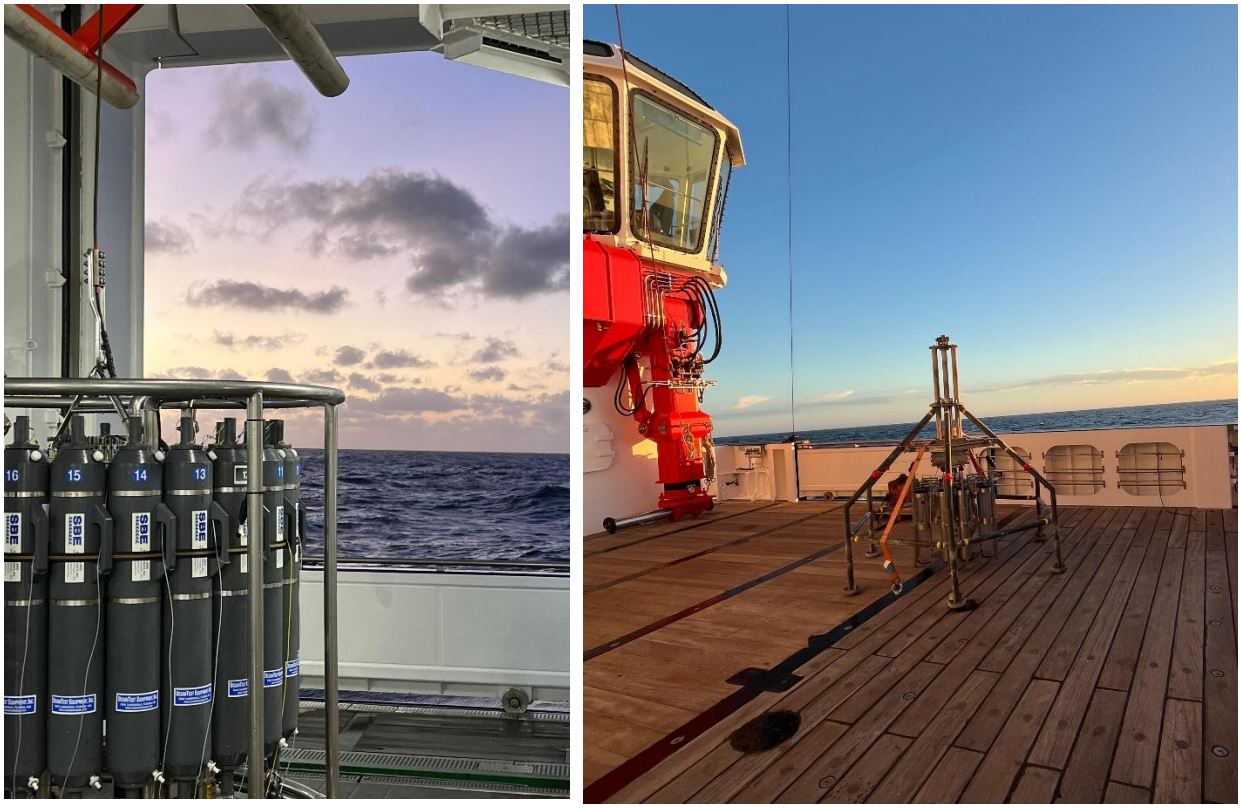
2. Weekly Report MSM133 - PARCAT

Sunset viewed from the deck of RV Maria S. Merian during the final evening of sampling on the MSM133 research expedition. The image was captured as we concluded our investigations of organic matter dynamics and nepheloid layers off the Mauritanian coast. (Image provided by Julia Pamphile dos Santos).

During the second week of our research cruise aboard RV Maria S. Merian, the scientific team has been fully immersed in exploring the Mauritanian shelf and slope region. Our work focused on two transects extending from the shallow shelf at approximately 100 m depth to the deep offshore waters at 2000–2500 m, as well as a dedicated 24-hour process study to investigate the formation and dynamics of nepheloid layers. These activities are integral to our overarching goal of understanding the vertical and lateral transport of organic matter in the ocean and its implications for carbon cycling and sequestration.

The science team has employed a diverse suite of state-of-the-art techniques and equipment to characterize both the pelagic and benthic environments. In the pelagic zone, water samples were collected to analyze particulate organic matter (POM) and dissolved organic matter (DOM) here both in situ pumps and the CTD-Rosette were used to collect samples. In situ camera profiles were performed to assess particle size distribution and abundance, and marine snow catchers were used to isolate and study sinking aggregates. Free-drifting sediment traps were deployed to measure

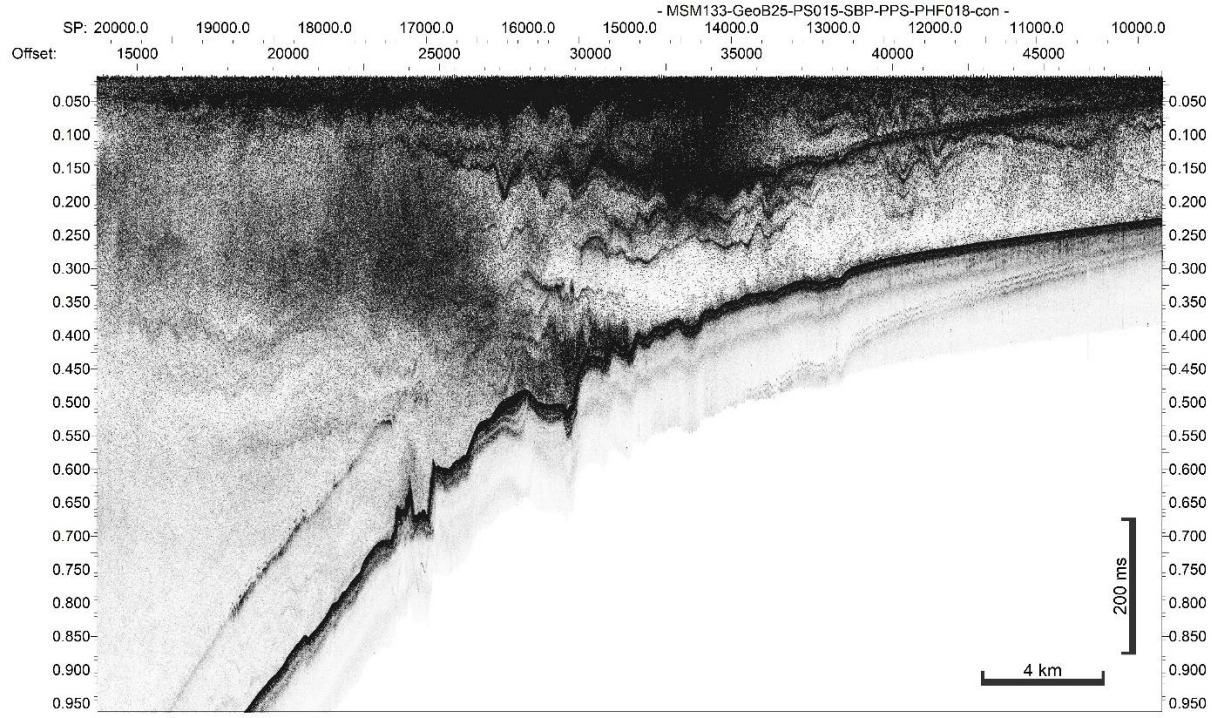
export fluxes, providing insight into the vertical transfer of organic carbon. For benthic investigations, sediment cores were retrieved using multi-corers to examine the composition and properties of surface sediments. These cores are essential for understanding the accumulation and alteration of organic matter on the seafloor. We used grabs to collected large volumes of sandy sediment for direct rate measurements of nutrient recycling. Hydroacoustic surveys were carried out using advanced systems, including acoustic Doppler current profilers (ADCP), Parasound, and multibeam echosounders, to map seafloor topography, assess current velocities and directions, and detect suspended and settling particles.



The CTD-Rosette (left) and the Multi-Sediment Corer (MUC, right) deployed during the MSM133 research expedition. The CTD-Rosette was used to collect water samples and measure conductivity, temperature, and depth, providing crucial data on the physical and chemical properties of the water column. The MUC allowed for the recovery of undisturbed sediment cores from the seafloor, enabling detailed analyses of organic matter composition and microbial activity in surface sediments. Both instruments were essential for investigating the vertical and lateral transport of organic matter in the Mauritanian shelf and slope regions. (Images provided by Julia Pamphile dos Santos).

A major highlight of this week was the 24-hour process study focused on nepheloid layers, which are turbid layers of water laden with fine particles. These layers play a pivotal role in the transport and redistribution of organic and inorganic material across the shelf and slope. We investigated both intermediate nepheloid layers, located within the water column, and bottom nepheloid layers,

adjacent to the seafloor. By combining hydroacoustic measurements with physical sampling, we aim to determine the sources and origins of nepheloid layers, trace their transport pathways and compositions, assess whether organic material within these layers undergoes turnover or is transported intact, and evaluate the role of these processes in the sequestration of carbon in deep-sea environments.



Parasound image showing a distinct nepheloid layer originating from the shelf break during the MSM133 research expedition. The dark signal highlights suspended particulate matter being resuspended and transported. This observation illustrates the dynamic processes at the shelf break, where strong currents, internal waves, and sediment resuspension contribute to the formation and extension of nepheloid layers, playing a crucial role in the lateral transport of organic and inorganic material towards the deep, open ocean. (Image provided by Elda Miramontes).

Initial analyses indicate substantial spatial variability in nepheloid layer characteristics across the transects. Near the shelf break, bottom nepheloid layers were particularly pronounced, likely driven by enhanced bottom currents, internal waves, and sediment resuspension. In contrast, intermediate layers exhibited distinct particle size distributions and were influenced by lateral transport processes. These findings align with our hypothesis that nepheloid layers serve as conduits for organic matter from the productive shelf to the deep ocean, potentially contributing to long-term carbon storage.

The interdisciplinary nature of this expedition continues to foster collaboration among scientists from MARUM, the Alfred Wegener Institute, the University of Oldenburg, the Max Planck Institute for Marine Microbiology, and the University of Bayreuth. The combined expertise in biogeochemistry, biochemistry, geochemistry, oceanography, and sedimentology is instrumental in addressing the complex questions surrounding organic matter transport and transformation.

On January 26th, we completed our final station, marking the end of the sampling phase of the expedition. At 15:20, we concluded a final deployment with our in situ camera and began steaming towards Las Palmas, where we will disembark the ship on January 31st. The team remains highly motivated, and all systems are operating smoothly. We are grateful for the excellent support from the RV Maria S. Merian crew, whose professionalism ensures the success of our mission.

Best regards,

Prof. Dr. Morten Iversen, Chief Scientist