

Topic: *Environmental impacts of deep-sea mining: geochemistry of suspended particles in the Clarion–Clipperton Zone*

Deep-sea mining may affect not only seafloor ecosystems and sedimentary geochemistry but also the overlying water column through the generation and dispersal of sediment plumes. However, it remains unclear how mining disturbances alter the elemental composition of suspended particles and how metal-bearing phases interact with seawater, potentially mobilizing toxic metals.

Within the JPI Oceans MiningImpact project (<https://miningimpact.geomar.de/>), mining tests were conducted in the Belgian (GSR) and German (BGR) contract areas of the Clarion-Clipperton Zone (CCZ), followed by multi-year monitoring and sampling campaigns. Suspended particulate matter from ambient bottom waters and mining-induced plumes was collected using seawater filtration and sediment traps. These samples provide an opportunity to characterize changes in particle composition and investigate how mining-induced disturbances influence the distribution, transport, and potential mobilization of trace metals within the deep-ocean water column.

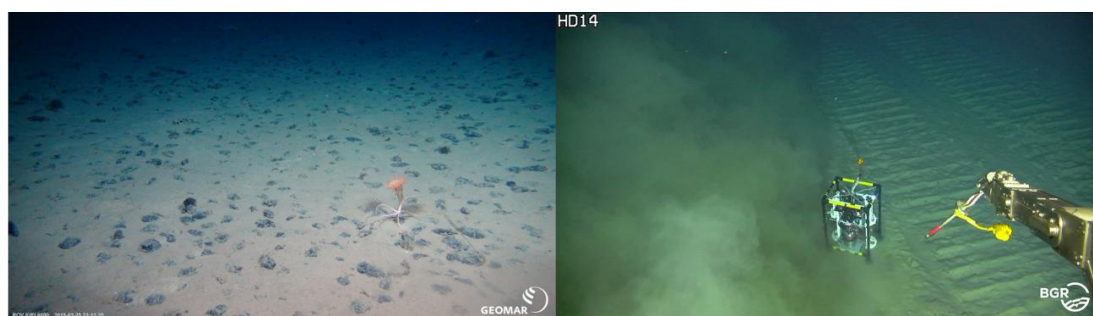
Objectives:

1. Geochemical analysis of suspended particles collected by seawater filtration and sediment traps before (SO268, 2019), during (IP21, 2021), and 1.5 (SO295, 2022) and 4.5 years (SO317, 2025) after the mining test.
2. Multi-year comparison to (1) establish a baseline of particulate trace metal distribution and lability between particle types and (2) assess the impacts of deep-sea mining and benthic plumes on the particle inventory in bottom seawater.

Methods: Sequential leaching of labile and refractory mineral phases of suspended particles and sediment trap material using published methods, microscopy (SEM/EDX), ICP-OES/MS measurements, data evaluation

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Start: as soon as possible



Images show (left; photo credit: GEOMAR) a manganese nodule habitat on the seafloor in the CCZ and (right; photo credit: BGR) the dispersal of a sediment plume along mining tracks.

Topic: ***Environmental drivers of spatial heterogeneity of surface sediment composition in the CCZ and impacts of deep-sea mining activities on sediment properties***

During research cruise SO317 in the northeast Pacific (Jan/Feb 2026), surface sediment was sampled in different working areas throughout the BGR contract area for the exploration of polymetallic nodules. The seafloor is variably but typically densely covered with polymetallic nodules, except for one working area. In 2021, the Belgian company GSR conducted a test mining trial in one of the areas, which since then is repeatedly sampled for environmental impact studies.

Objectives: Characterization of natural physical properties and the mineralogical and geochemical (elemental, organic carbon) composition of surface sediments in different parts of the BGR contract area; characterization of impacts of deep-sea mining (DSM) activities on sediment properties 4.5 years after the disturbance (Patania II trial). Data should be integrated with oxygen and macronutrient data (provided), and other ancillary data (such surface productivity, bottom water current speeds, bathymetry, sedimentation rate), to evaluate potential environmental drivers of spatial heterogeneity of surface sediment properties, and to evaluate effects and suitable indicators of DSM activities.

Methods: sediment preparation (homogenization/drying/milling), sediment sieving, mineralogy (SEM, XRD), microwave digestion and ICP-OES/MS measurements (possibly also TOF-ICPMS), data evaluation

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Pictures show a nodule-covered seafloor in the CCZ and a sea anemone (left), and sediment sampling with push cores in an area cleared from nodules(right).