

Natural variability of geochemical conditions, biogeochemical processes and element fluxes in sediments of the eastern CCZ, Pacific Ocean

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The abyssal seafloor in the equatorial Pacific Ocean bounded by the Clarion and Clipperton Fracture Zones (CCZ) is covered by polymetallic nodules. The International Seabed Authority (ISA) has granted exploration license areas in the CCZ and declared nine Areas of Particular Environmental Interest (APEIs). The APEIs are excluded from any mining activities and are designated for the protection of biodiversity and ecosystem functioning. However, little is known about the spatial variation in sediment geochemistry across the license areas and the APEIs. We present a comparative study on six sites on (1) the redox zonation in the sediments and (2) the dominating biogeochemical processes.

As part of the EU-BMBF funded JPI Oceans Pilot Action „Ecological aspects of deep-sea mining“, we visited five European license areas and the APEI3 located north of the CCZ during RV SONNE cruise SO239 in 2015. The recovered multiple and gravity cores were sampled for comprehensive pore-water and solid-phase analyses.

Due to low POC fluxes of $< 2 \text{ mg m}^{-2} \text{ d}^{-1}$ and low sedimentation rates of $0.18\text{-}1.15 \text{ cm kyr}^{-1}$ the upper oxic zone extends from 1 to $> 6 \text{ m}$ sediment depth. Aerobic respiration is the dominant process and accounts for 90% of the organic carbon degradation whereas denitrification is negligible. Below the oxygen penetration depth (OPD), Mn^{2+} is released into the suboxic zone and coexists with NO_3^- . At several sites the Mn^{2+} pore-water profiles indicate an upward diffusion of O_2 from the underlying basaltic basement.

The distinctly different geochemical conditions found in the six areas result from differences in (1) surface water productivity and POC flux, (2) sedimentation rates, (3) deep Mn reduction and (4) diffusive upward flux of O_2 from the basaltic basement. The conditions at the APEI3 site differ significantly from the geochemical settings in the investigated European license areas.