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Biomass and activity of microbial assemblages associated with polymetallic nodules and implications for the carbon cycle

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Discovered in the 1870's the polymetallic nodules are nowadays recognized as a widespread feature of the worldwide abyssal plains (4000-6000 m water depth). Although several studies investigating the diversity of 16S RNA genes have shown that nodules host specific microbial communities, so far the standing stocks and activities of these microbes remains unknown. In this study, we investigated the abundance and extracellular enzymatic activity (EEA) of microbial assemblages associated with polymetallic nodules collected from the Clarion Clipperton Zone (CCZ) in the equatorial Eastern Pacific at 4050-4550 m water depth across a spatial scale of approx. 1000 km. During RV SONNE expedition SO268, 58 nodules were collected by box-corer and remotely operated vehicle (ROV). Aliquots of the nodules were taken from three different microenvironments: the upper part exposed to seawater, the nodule core and the bottom part buried in the sediments. The total abundance of microbial cells was estimated via acridine orange direct counts (AODC), and active bacterial and arachaeal cells were enumerated applying catalysed reporter deposition-fluorescence *in situ* hybridization (CARD-FISH). EEA measurements were carried out to assess the potential hydrolysis rates of several different enzymes (i.e. aminopeptidase, chitobiase, glucosidase, esterase). Our results provide for the first time a quantitative estimate of the microbial biomass hosted by polymetallic nodules and their potential contribution to organic matter degradation. The role of the nodule-hosted microbial community in the benthic carbon cycle is depicted by comparison with sedimentary data including sedimentation rates and relations with characteristics of the nodules themselvers, in terms of their organic matter content, the presence of sessile epifauna (i.e. corals or anemones) on them, as well as their density. The potential impact on C pools and cycle caused by the removal of polymetallic nodules by deep-sea mining activities will be also discussed.