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Recent Observations of the Bottom Mixed Layer in the Tropical Northeast Pacific Ocean

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The bottom mixed layer (BML) is a well mixed, weakly stratified bottom boundary layer adjacent to the seafloor, with a thickness of the order 10-100 m, and is considered a common feature of the deep water column in the ocean. First observed in the 1970s and documented extensively in the deep Northwest Atlantic Ocean in the 1980s, the abyssal ocean (depth > 4000 m) BMLs have not been well observed in other regions of the global oceans, particularly in the Northeast Pacific Ocean, and the dynamical processes that lead to their formation are not well understood. Turbulent diffusivity in the BML is estimated to be greater than in the interior ocean by an order of magnitude, and the presence of such layers is often associated with elevated level of turbidity and episodic events of sediment resuspension and transport, known as the benthic storms. Without a clear understanding of the variability and dynamics of these layers, assessing potential environmental impacts of proposed commercial activities in the deep sea, such as the exploitation of polymetallic nodules in the Clarion-Clipperton Fracture Zone (CCFZ) in the tropical Northeast Pacific, is challenging.

In this study, we analyze observed profiles from conductivity-temperature-depth (CTD) measurements recently collected in the German licence area of the CCFZ, a region with abyssal hills west of the East Pacific Ridge. Quasi-uniform profiles of potential temperature, salinity, and potential density extending from the seafloor to a maximum of 475 m above bottom (mab) reveal the presence of a BML in the region with a thickness of O(100 m), using a mixed-layer quantification method based on potential temperature profiles. The BML thickness and structure vary both temporally and spatially, with three major characteristics: (i) a well-developed, statically stable BML with a thickness between 200 and 475 m; (ii) a less well-developed BML with a thickness of approximately 100 m; and (iii) a well developed BML with a thickness of around 400 m and multiple intrusive layering structures, each of which with a thickness of approximately 100 m, near bathymetric reliefs. These findings confirm the preliminary findings from the 1980s that benthic stratification in the region is weak and that a mixed layer may be present at the bottom. While our preliminary findings establish the presence of BML in the region, questions regarding

the dynamical processes responsible for the temporal and spatial variabilities remain to be addressed. Further analyses using data from the eastern segment of the World Ocean Circulation Experiment (WOCE) tropical North Pacific (P04E) section are ongoing to understand the spatial variability of these layers in the region.