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Observational evidence of diapycnal upwelling in a bottom enhanced mixing environment

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In the framework of the Peruvian Oxygen minimum zone System Tracer Release Experiment (POSTRE) about 70 kg of trifluoromethyl sulfur pentafluoride (SF5CF3) was injected into the bottom boundary layer of the upper Peruvian continental slope at 250m depth in October 2015. Three different injection sites, at 10°45'S, 12°20'S and 14°S were selected. At the tracer release sites and due to tide-topography interaction, mixing above the upper continental slope of Peru was intensified. Turbulent dissipation rates increase by about an order of magnitude in lower 50 to 100m above the bottom. During previous tracer release experiments, where tracer was injected into the stratified mixing layer above the bottom boundary layer, a change of the center of mass toward higher densities resulted. Newer theories suggest that this diapycnal downwelling is balanced by a diapycnal upwelling within the bottom boundary layer. Indeed, during the tracer survey it was found that the density of tracer's center of mass had decreased by 0.13 kg m^{-3}. This corresponds to an upward displacement of 70-100m. Using microsctructure shear data from 8 cruises, we obtain a diapycnal velocity of about 0.5 m day^{-1} within the bottom boundary layer. This suggests that on average, the tracer was trapped within the bottom boundary layer for a period between 1.5 and 3 month. Overall, our tracer study provides the first observational evidence of diapycnal upwelling occurring within the bottom boundary layer of a bottom enhanced mixing environment and supports recent ideas of a vigorous global overturning circulation.