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Deep ocean mixing in the South Pacific: implications from the distribution of mantle ^{3}He

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Turbulent exchange (mixing) coefficients (k_z) determined for the deep ocean using various techniques range from roughly 10^{-5} m^2 s^{-1} in the interior of deep ocean basins over flat topography to almost 10^{-3} m^2 s^{-1} over rough ridge topography. Here we examine the utility of mantle ^{3}He for determining deep ocean mixing coefficients. Mantle ^{3}He is injected into the deep ocean at mid-depth (ca. 2500 meters) through hydrothermal vent activity typically sited on the Mid-ocean Ridge system. Thus, the typical ^{3}He profile in the ocean has a maximum at a depth close to that of the MOR crest with values decreasing towards the surface and the bottom water. While spreading on isopycnal surfaces from the injection sites throughout the deep basins of the world ocean, its distribution is modified by vertical turbulent exchange. Using the ^{3}He data base available for the South Pacific we utilize the observed mid-depth maximum in the ^{3}He distribution to constrain deep ocean mixing coefficients for this region. Specifically, we use a simple 1-D advection/diffusion model with a mid-depth ^{3}He source to simulate the ^{3}He profiles for the South Pacific and compare them with the observations available for this ocean basin. Our first results indicate that the basin-scale, long-term average of the deep ocean vertical exchange coefficients is close to 10^{-4} m^2 s^{-1}.