



A new theory of the abyssal ocean circulation

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It has long been recognized that the large-scale circulation of the abyssal ocean is enabled by small-scale diapycnal mixing. Theories developed in the fifties and sixties posited that the diapycnal mixing drives widespread upwelling of abyssal waters and broad poleward meridional flows. We will argue that these predictions need to be revised in view of observations collected over the last twenty years which suggest that mixing is strongly enhanced towards the ocean bottom, where the breaking of internal tides and lee waves is most vigorous. The bottom-intensified mixing induces a pattern of near-bottom up- and downwelling that is quite different from the traditionally-assumed widespread upwelling. The up- and downwelling flows result in a horizontal circulation characterized by zonal flows, while the meridional flows are confined along the ocean's western boundaries. We will discuss the implications of these circulation patterns for the residency time of abyssal waters in the ocean and for the role of the abyssal ocean on Earth's climate.