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Topographic Effect on the Deep Circulation and the Abyssal Oxygen Distribution

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ABSTRACT

Stommel's model for deep circulation of the World Ocean is extended to include the effect of bottom topography. Bottom friction is introduced to dissipate the vorticity which is generated by stretching of the water column due to upwelling. The steady linearized equations governing the flow were solved for the World Ocean with actual bottom relief and coastline. The topographic flow of the World Ocean is then used in the advection-diffusion-decay equation to examine the effect of the topography on the abyssal oxygen distribution. The resulting topographic flow is quite different from the circulation with a flat bottom, particularly in the Antarctic region. The Antarctic Circumpolar Current obtained here gives the essential feature that the current bends toward the equator when approaching a shallow area and toward the pole after crossing it. The distribution of abyssal oxygen is characterized by the topographic flow. The contours of the oxygen concentration in the Antarctic Ocean resemble the stream lines of the flow. When the advection process is larger than diffusion, the interior distribution of oxygen also shows the influence, of the mid-ocean ridges and the Hawaiian Islands.

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