Abstract View

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Deep Flow along the Western Boundary South of the Blake Bahama Outer Ridge

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ABSTRACT

In June–July 1990, hydrographic, chlorofluorocarbon (CFC), and velocity observations were taken along the western boundary of the North Atlantic south of the Blake Bahama Outer Ridge from 30° to 24°N between the northern Bahamas and 71°W. The deep flow in the region, associated with the deep western boundary current, forms a pattern of strong, narrow currents and cyclonic gyres close to the continental slope with broad, slower southward flow offshore. The CFCs reveal that the most recently "ventilated" water (i.e., having the highest CFC concentrations due to more recent contact with the atmosphere in the northern North Atlantic) is found along the western boundary in two distinct cores between potential temperatures 4°–6°C and 1.9°–2.4°C. Geostrophic transport streamlines were constructed for the deep flow, referenced using direct velocity observations at 26.5°N and assuming mass conservation between closed areas bounded by the hydrographic sections. The tracers and transports are used together to describe the deep circulation in the region, to determine the origins and pathways of the various flow components, to define the spatial scales and strengths of the deep currents and recirculation gyres, and to examine their relationship to bottom topography and their possible role in ventilating the interior. The close correspondence of the tracer distributions with the regional bottom topography implies that the major topographic features in this region strongly influence the deep circulation. The geostrophic transport for the narrow branch of current having the highest CFC concentration, which transits the region and continues equatorward adjacent to the western boundary, is 31 Sv (Sv ≡ 10^6 m^3 s^{-1}) below 6°C. A

cyclonic gyre with one or more embedded gyres extends offshore of the narrow boundary current out to about 74° W, transporting 12 Sv of water with intermediate CFC concentrations. Farther offshore, a broad band of southward flow contributes an additional 16 Sv of water with considerably lower CFC concentrations. Thus there is a total deep (<6°C) equatorward transport through the study area along the western boundary of 47 Sv at 24°N. The layer containing the shallower CFC core (4°–6°C) appears to be less constrained by the bottom topography. Within this temperature layer, one current branch with high CFC and low salinity flows southward along the Blake Escarpment. However, there is another branch of flow within this layer that forms an extended zonal high CFC and high salinity distribution from the eastern to the western bounds of the study region. This second branch apparently originates in the Gulf Stream recirculation and carries the higher salinity influence of the Mediterranean Water.

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