Abstract View

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Form of the Temperature-Salinity Relationship in the Central Water: Evidence for Double-Diffusive Mixing

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ABSTRACT

Ingham (1966) reported that the temperature-salinity relationships in the Central Waters were much better described by a curve of constant density ratio ($R\rho = \alpha\Delta T/\beta\Delta S$) than by a straight line. His result is quantitatively verified and a simple, but powerful, double-diffusive mechanism is proposed to explain the observed constancy of $R\rho$ in the main thermocline. The mechanism is based on the evidence from theory, experiment and observation that the intensity of salt-finger convection is a strong function of $R\rho$. This dependence, plus the fact that more salt than heat is transferred by the fingers, causes any deviation from a constant $R\rho$ to be the site of convergence or divergence of the vertical salt flux that acts to remove the perturbation in $R\rho$. A linear treatment of the mechanism shows that $R\rho$ can be "diffused" with an effective diffusivity that is much greater than the diffusivities of heat or mass. A few numerical examples illustrate the predicted effects of salt fingering on the T-S relation, showing that a constant $R\rho$ is the basic state of a fluid in which some salt fingering is taking place. The model suggests that the large scale T-S relation may be controlled as much by the details of the microscale diffusive processes as by the large-scale atmospheric forcing.