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CLIMATOLOGY AND DYNAMICS OF THE EASTERN LEVANTINE BASIN

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Seventeen cruises carried out over a period of six years in the Eastern Levantine Basin have been analyzed. The seasonal and interannual variability of the water properties and the kinematics of the circulation of this region is identified and described. We use EOF's to describe the vertical variability of the dynamic light profiles and to construct absolute geostrophic stream functions fields for each cruise. Optimal interpolation techniques were applied to the analyzed data set and sensitivity experiments were carried out for different horizontal correlation functions. The regional climatological Brunt-Vaisala frequency was used for the determination of the local dynamical baroclinic modes and the local Rossby radii of which is approximately 12 km deformation. We discovered a very intense mesoscale eddy field associated with scales of motion ranging from one to several local Rossby radii of deformation.

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THE UNIQUE STEP STRUCTURE OF THE TYRRHENIAN SEA

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An extensive study was undertaken during October 1979 of the thermohaline step structure that occurs beneath the Levantine Intermediate Water (LIW) in the Tyrrhenian Sea. Temperature and salinity observations confirmed the existence of a series of 8–12 homogeneous layers of 15–250 m thickness, each separated by sharp thermohaline gradients of the order of 0.1°C and 0.02 ppt. over 2 m, which extend from the base of the LIW at 500 m to depths in excess of 2000 m. The lateral extent of the structure was 25,000 km^2, centred around the Vavilov Seamount, with the deeper layers persisting throughout the surveyed region. Comparisons with studies by previous investigators demonstrates that many of the layers were coherent over periods greater than 7 years.

Salt fingering has been directly observed to occur across the layer interfaces using shadowgraph techniques (Molcard and Williams, 1975); the LIW providing the necessary salinity for salt fingering to take place. Double diffusive theory indicates that this mixing process has an important role to play in the formation and evolution of the structure. Because of the ubiquity and stable characteristics of LIW, particularly in the Western Mediterranean, conditions should be favourable for step structures to occur throughout the Mediterranean. However, such extensive structure has only been reported to occur beneath the Mediterranean outflow (Tait and Howe, 1971). This suggests that a second mixing process is necessary in the ocean to help initiate the layer formation which then develops under the influence of salt fingering: in the Tyrrhenian Sea this process is proposed to be internal wave breaking on the Vavilov Seamount.

The Tyrrhenian step structure differs from that beneath the outflow, or any of the others found in the ocean, by its long term stability and the thickness of its deeper layers. Theory predicts that the observed conditions should produce layers with a maximum thickness of the order of 25 m; similar predictions had proven correct in other regions (Elliott and Tait, 1977). In addition the temporal stability of similar phenomena is at most weeks, not years. It is suggested that the evolution of the Tyrrhenian structure has been strongly influenced by the bathymetry of the basin. Salt vertically transported by salt fingers must be advected away from the system in some way. However the bathymetry limits this advection to the intermediate layers, which must have led to a build up of salt in the deeper layers, causing them to merge. An equilibrium state has been reached, composed of a system of thinner shallow layers with thicker deeper layers. Not only are these deeper layers inherently more stable, by their volume, to small disturbances but they can also control the advection of salt away from the region. Thus, with the effect of the stable, deeper layers as the consistency of the LIW a feedback process operates, ensuring the long term stability of the layered structure. In most other instances of this type of layering either the driving mechanism or the horizontal "venting" of salt is variable leading to a more ephemeral structure.

Elliott A.J. and Tait R.I. (1977) "On the steady-state nature of the Mediterranean outflow step structure". A Voyage of Discovery (Ed. M. Angel) Pergamon Press: 696pp.

Molcard R. and Williams A.J. 3rd (1975) "Deep step structure in the Tyrrhenian Sea". Mem. de la Soc. Roy. des Sciences de Leige, 6 eme Serie 7:191–210.

Tait R.I. and Howe M.R. (1971) "Thermohaline staircase". Nature 231:178–179.