DEEP CIRCULATION AND MIXING IN THE TYRRHENIAN SEA: MORE THAN 10 YEARS OF DATA

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Abstract
This investigation aims to explore the variability of the hydrological characteristics of the Tyrrhenian basin water masses in the last 12 years, with particular attention to the Sicily channel inflow. Data collected consist of a long time series of two deep repeated CTD stations in the Tyrrhenian sub basin, whose specific feature is the well defined and permanent step-like profile of the water column. Despite the sability of the basin a rising trend of the staircases can be highlighted in the time series, and the whole water column movement can be linked to recent changes in the deep layers. This investigation will estabilish if this link is plausible or the staircase movements are of different nature.

Keywords: Deep waters, Tyrrhenian Sea, Turbulence, Circulation, Hydrology

This study aims to underline if and how recent changes in the Western Mediterranean circulation affect the water column structure and the deep stratification of the Tyrrhenian basin. Previous studies [1] show that significant changes, such as salinification and preconditioning to dense water masses formation, observed up to 2004 in the western Mediterranean basin were mostly related to the Eastern Mediterranean Transient (EMT). In the subsequent years the presence of a new layer of deep water was observed, showing higher salinity, temperature and density with respect to the resident deep water previously observed. This new, denser layer was produced to an exceptional deep water formation event in winter 2004/05 [2], and it is now spreading at the bottom of the western basin, setting the beginning of the Western Mediterranean Transition (WMT), which changed the basic structure of the intermediate and deep layers in the Western Mediterranean. An important consequence of the WMT is, in particular, a perturbation of the deep Tyrrhenian Sea, due to the propagation of these anomalies through the Sardinian Channel, observed for the first time after 2010.
One of the main features in a typical vertical profile of the water column of the Tyrrhenian basin is a step-like structure, due to double diffusion processes, which has a strong impact on the vertical mixing rates. Indeed when the bottom slope does not influence the water motion anymore, as in the Tyrrhenian basin, the mixing is entirely ascribable to molecular diffusion via finger instability [3].

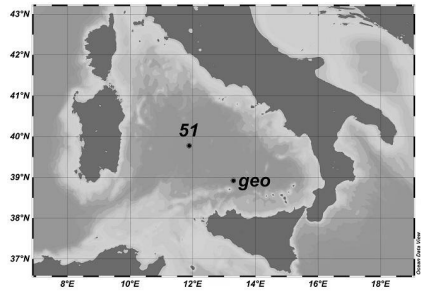

Fig. 1. Map of the two stations

In both of the two control stations analyzed in the middle of the Tyrrhenian sea (Fig. 1), among over 10 years of measurements the step-like profiles of the water columns are considerably superimposable, and seems to be very stable. Despite, a vertical raising of the whole profile in time is highlighted, as it can be seen in Figure 2 in particular for stn 51.
One of the possible explanations for the raising of the steps is the new deep water entering the Tyrrhenian basin, moving them upwards.
To prove this hypothesis a method developed by Bindoff and McDougall [4] is now under test for the specific Tyrrhenian case, in order to identify the contribution of pure warming, pure freshening, pure heaving mechanis, and to discern if the displacements seen in the whole water column profile in time are due to internal or external forcings such as the new deep water layer pushing from the bottom of the basin.

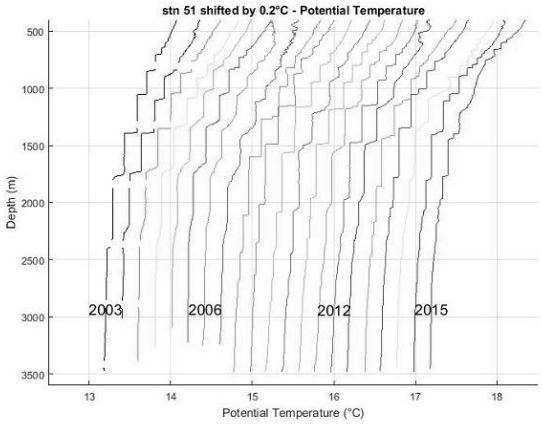

Fig. 2. Historical series of Potential Temperature for one of the two control deep Tyrrhenian station (stn 51), shifted by 0,2°C form 2003 to 2015, to better underline the similarity among the profiles and the rising trend.

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