

Deep convection in the Levantine Sea

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Thermohaline analysis of the deep water in the Eastern Mediterranean shows (El-Gindy, El-Din, 1986), that in their formation besides Adriatic and Cretan waters also participate the water of the Levantine Sea (5-15%).

Most of the favourable conditions, under which the winter convection in the Levantine Sea can be developed down to great depths, were occurred in the Rhodos gyre area. The center of eddy activity appeared as a source of the LIW formation (Ovchinnikov, I.M., 1983, 1984), under moderate winter conditions in 1977 and 1982, and with the convection mixing to be in the "pre-condition phase" (MEDOC Group 1969) reaching the depths of 150-200m. Modeling of this process showed that under more severe winter conditions, when in the center of Rhodos gyre the water cooling reach $\leq 14^{\circ}\text{C}$, the convection can be spread down to the bottom participating in the formation of the Eastern Mediterranean deep water (Ovchinnikov, Plachin, 1984). Field experiment on the board of R/V "Jacob Gakkel", during more severe winter conditions 1987, confirm the numerical computation results (Gertman, Popov, Trigoup, 1987).

Before the time of our field works, arctic air invasion occurred from 2 to 5 March 1987 in the Rhodos gyre area. Then, during the first phase of the sampling period (7-23 March 1987), the north-western air (with speed up to 20m/sec) predominated with the Ta-Tw to be varied from 4 to 10 deg.C. At the same time the daily (13/3/1987) maximum heat loss in the area of Rhodos gyre reached the value of 76 Mjoule/m². Similarly at the MEDALPEX experiment (March 1982), during the deep water formation in the western basin, the maximum heat loss was 60 Mjoule/m² (Vakalyuk, Gudz, Popov, 1987). Therefore more greater heat loss from the sea surface, during the arctic air invasion in the Rhodos gyre area (2-5/3/1987), resulted the formation of the surface cool (14deg.C) and dense (29.25) water which exceeded the density of the water layer below them (29.20). This caused an active convection mixing down to 700m (Fig.1), corresponding to the "energetically mixing phase". During this phase the dense water was sunk along of the formed water dome, while in the center of the water dome, water from the intermediate layer was raised to the surface. In the moment of the field sampling, less saline water (38.8-38.9) raised from the intermediate depths to the surface and restored the stratification in the surface layer. Therefore in the layer below it the convection mixing turned into the phase of "sinking and spreading".

Comparison of the observations, sampled one month after (during the second phase (16-23/4/1987) with the results sampled during the first phase, showed that the restoration of the thermohaline structure in the area of the water dome occurred mainly from the horizontal turbulence and the gradually density stratification in deep layers. The changes which observed during the one month period, permit us to assume that the complete disappearance of the water dome may occur in the following 2-3 months, up to the middle of the summer.

We have to mention that the deep convection in the Rhodos gyre area (down to 800-1000m) observed also during winter 1989 and 1990.

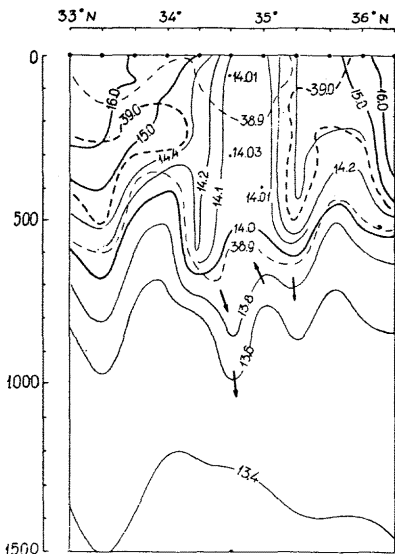


Fig.1. Temperature and salinity, south-north section along 28° 40' E 14-16.03.87 (R/V Jacob Gakkel)

REFERENCES

- El-Gindy, A.A.H. and El-Din, S.S.H., 1986. Water masses and circulation patterns in the deep layer of the Eastern Mediterranean, *Oceanologica Acta*, vol.9, N°3, 239-248.
- Gertman, I.F., Popov, Y.I., Trigoup, V.G., 1987. Evidence of deep convection in Levantine Sea (March 1987), UPK 551.465.41(262), Sevastopol, VINITI B.09.1987 N°6581-B87.
- MEDOC Group, 1969, Lacombe, H., Tchernia, P., Ribet, I., Frasset, R., Swallow, I.C., Millier, A.R., Stommel, H., 1970.
- Observation of formation of deep water in the Mediterranean Sea, 1969. *Nature* 1970 vol.227, N°5262, 1037-1040.
- Ovchinnikov, I.M., 1983. On the renewal of the major water masses of the Mediterranean Sea, *Oceanology*, T.23, N°6, 960-962.
- Ovchinnikov, I.M., 1984. Intermediate water formation in the Mediterranean Sea. *Oceanology*, T.24, N°3, 217-225.
- Ovchinnikov, I.M., Plachin, E.A., 1984. Formation of Mediterranean intermediate water in Rhodos cyclonical gyre. *Oceanology*, T.24, N°3, 417-420.
- Vakalyuk, Y.V., Gudz, P.K., Popov, Y.I., 1987. Thermohaline and dynamic structure of the water of the Ligurian Sea according to MEDALPEX data. *Anales Geophysica* 58(1), 31-36pp.