

R. NAIR*, E. CATTINI*, G.P. GASPARINI+ and G. ROSSI*

* ENEA, S.Teresa, L'Á SPEZIA (Italia)

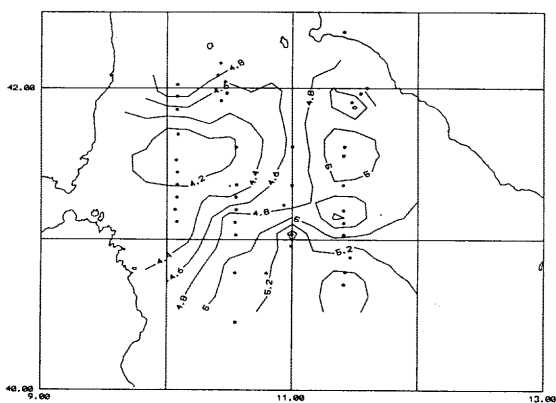
+ CNR Stazione Oceanografica, POZZUOLO di LERICI (Italia)

Nearly all studies (i.e. HOPKINS, 1988) pertaining to the Tyrrhenian sea show that this area is characterized by upward and downward fluxes between Modified Atlantic Water, Levantine Intermediate Water and Deep Water. BETHOUX (1981) in his estimate of the potential fertility of the Tyrrhenian Sea attributes about 2/3 of its primary production to the effect of vertical fluxes on the availability of nutrients to phytoplankton. Additionally, these processes exhibit a large spatial variability due to the peculiar features of the circulation which is characterized by many cyclonic and anticyclonic vortices. The main forcing mechanism is the wind stress curl. The associated Ekman pumping, together with the inflow/outflow at the openings, seems to drive the circulation of the whole basin (ASTRALDI *et al.*, 1991). In particular, while the central area of the southern part of the basin appears very stable, a well developed upwelling is present in the northern part (MOEN, 1984).

The present study attempts to provide a description of the characteristics of the water masses of the North Tyrrhenian Sea utilizing not only their physical but also their chemical properties. Our data, obtained in the late summer of 1989 and in the winter of 1990, indicate, on the basis of temperature, salinity, oxygen and nutrient measurements, the persistence of a zone of upwelling during both periods. This is also seen in the Levantine Intermediate Water, whose core, observed usually below 500m, was found here at a depth lesser than 400m. The upper layer of this zone is characterized by relatively lower temperatures and oxygen concentrations (Figure) and by higher salinities and nutrients.

The structure is also evident in the distribution of nitrates and phosphates. In summer, it is possible to distinguish two areas where these nutrients occupy distinct ranges of concentration, though phosphates exhibit this spatial differentiation in a much weaker manner. The behaviour of these parameters during this period point to the presence of a well developed front that is less visible in winter.

During winter, there seems to be a marked overlapping of the observed ranges for both parameters in the two areas which may be induced by the more uniform vertical fluxes associated with winter mixing. Phosphates show much higher values in winter and the N:P ratio is therefore affected more by the behaviour of phosphorous than by that of nitrogen. This may be due to the influx of the settling products of phosphate remineralization in winter and the greater degree of mixing during this period. The enrichment of the euphotic zone through this vertical upward flux would augment the existing nutrient resources supporting probably a much higher primary production than would exist in the absence of these physical processes.



Oxygen (ml/l) at 100 m depth (Winter 1990)

REFERENCES

- ASTRALDI M., ARTALE V., BUFFONI G. & GASPARINI G.P., 1991.- TEMPO Experiment: seasonal eddy variability in the north Tyrrhenian sea, submitted to *J. Geophys. Res.*
 BETHOUX J.P., 1981.- Le phosphore et l'azote en Mer Méditerranée, bilans et fertilité potentielle. *Mar. Chem.*, 10, 145-158.
 HOPKINS T.S., 1988.- Recent observations on the intermediate and deep water circulation in the Southern Tyrrhenian Sea, *Oceanologica Acta*, Special Issue n.9, 41-50.
 MOEN J., 1984.- Variability and mixing of the surface layer in the Tyrrhenian sea: MILEX-80, Final Report. SACLANTCEN Report SR-75, 128 pp.