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The role of horizontal exchanges on ventilation of the benthic boundary layer on the Black Sea shelf

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The state of the benthic component of the shelf ecosystem is strongly influenced by availability of dissolved oxygen. The chemical structure of the Black Sea waters is largely determined by the location and the strength of the pycnocline. Due to similarity in the mechanisms of vertical exchanges the oxycline and the chemocline occur at the same depth intervals as the halocline and pycnocline (Özsoy and Ünlüata, 1997). As the data for dissolved oxygen on the shelf is relatively sparse we assume that much abundant data on physical parameters (temperature and salinity) can be used as proxy in determining the location of the oxycline and hence the spatial extent of near-bottom waters depleted in oxygen.

When the waters of the benthic boundary layers below the pycnocline are 'locked' i.e. unable to mix vertically with surface then the biological pump and supply of oxygen are suppressed. However, the locked water can, in principle, move 'horizontally', predominantly along the constant density levels and get ventilated via isopycnal exchanges. The isopycnals in the Black Sea have generally a dome-like structure, so that the isopycnal movements across the shelf break can ventilate bottom shelf waters with water masses from upper parts of the water column in the deep sea.

We use the intra- and inter-annual variations in the near-bottom temperature as indicators for variability of physical conditions in the benthic boundary layer on the shelf. The physical reason for this is that interannual variations in the near-bottom temperature are directly related with the volume of cold waters (Ivanov et al., 2000) which are formed on the shelf and then exported into the deep sea, so that variations in temperature may indicate changes in the intensity of horizontal exchanges.

In this paper we identified areas on the Black Sea margin where bottom waters can not be mixed vertically ('locked' waters) during the winter months and locations to which the locked waters can move 'horizontally'. The potential energy approach was used to identify the spatial and temporal variability of the areas and volumes occupied by the locked waters. This approach allows to assess a relative strength of the ability of locked waters to mix vertically with oxygen rich surface waters as compared to 'horizontal' exchanges with the deep sea along isopycnic surfaces. Analysis of interannual variability of temperature showed that the period 1965-1983 was a warm period when the 'summer' season (May to November) temperatures of the benthic waters were higher than the average; to the contrary the period 1983-2001 (i.e. up to end of available data sets) was a cold period.

Correlations between various time series of hydrographical and meteorological parameters were calculated to establish the relative importance of vertical versus horizontal exchanges in ventilation of the locked water masses. A low correlation (R=0.24) was obtained between the variation of the winter sea surface temperature on the shelf and the 'summer' temperatures of locked waters. A higher correlation (R=0.56) was found between the summer temperatures of the Cold Intermediate Waters below the seasonal pycnocline in the deep sea (density range sigma-theta= 14.2-14.8) and the 'summer' temperatures of the 'locked' waters in the benthic boundary layer on the shelf. Analysis shows that the isopycnic exchanges with the deep sea are more important for ventilation of the benthic boundary layer on the shelf than winter convection on the shelf itself.

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References

Özsoy, E. and Ünlüata, Ü., 1997. Oceanography of the Black Sea: a review of some recent results. Earth-Sci. Rev., 42(4): 231-272.

Ivanov, L.I., Belokopytov, V.N., Özsoy, E. and Samodurov, A., 2000. Ventilation of the Black Sea pycnocline on seasonal and interannual time scales. Mediterr. Mar. Sci., 1/2: 61-74.