

# **Baltic Sea Research Institute Warnemünde**

## **C r u i s e R e p o r t**

R/V " Prof. Albrecht Penck "

Cruise- No. 40 / 97 / 04

This report is based on preliminary data:

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1. **Cruise No.:** 40 / 97 / 04
2. **Dates of the cruise:** from 25.02.1997 to 08.03.1997
3. **Particulars of the research vessel:**  
Name: Prof. Albrecht Penck  
Nationality: Germany  
Operating Authority: Baltic Sea Research Institute (BSRI) Warnemünde
4. **Geographical area in which ship has operated:**  
Bornholm Basin: (55°-55°35') N, (15°20.7' - 16°26.2') E
5. **Dates and names of ports of call**  
no
6. **Purpose of the cruise**  
Exchange processes in deep meso-scale mass-field patterns
7. **Crew:**  
Name of master: O. Albrecht  
Number of crew: 10
8. **Research staff:**  
Chief scientist: E. Hagen  
Scientists: R. Feistel  
P. Zorn  
Engineers: S. Weinreben  
Technicians: W. Hub
9. **Co-operating institutions:**  
no
10. **Scientific equipment** Sea-Bird CTDO - probe
11. **General remarks and preliminary results** (ca. 3 pages)

Warnemünde, 12 March, 1997

Because of their depth and central location the deep basins are probably the most interesting regions for theoretical and experimental investigations in the context of thermodynamics and/ or kinetics of oceanic irreversible processes. There is some observational evidence that much of the diapycnal mixing is actually done before the dense deep water is incorporated into deep waters of the Baltic Proper. Associated processes of detrainment essentially modify dense bottom currents spreading from the Arkona Basin through the Bornholmstrait into the Bornholm Basin.

Our hydrographic activities support running BASYS (*Baltic Sea System Study*)-field campaigns and contribute to the Russian- German field study programme „Research on the Baltic Sea (RBS)“, which is partly funded by the Ministry of Science and Technical Politics of the Russian Federation and the Federal Ministry of Education, Scientific Research and Technology of the FRG. That programme runs for three years (1996- 1998) above deep Baltic basins to provide eddy-resolving data sets with a station spacing of about 2.5 n.m. to study exchange processes of water properties between different basins as well as between coastal zones and central parts of the Baltic during different seasons.

The investigation of exchange processes between different basins of the Baltic Sea have been started - by CTD-measurements in the Stolpe Furrow, which connects the Bornholm - with the Gotland Basin, during March, 1996. Similar campaigns were carried out in the Gotland Basin (June, 1996), the Bornholm Basin (September, 1996), and the Arkona Basin (December, 1996). Similar activities will be continued in the Stolpe Furrow (June, 1997), and in the eastern Gotland Basin (September, 1997). In the following two years, repeated measurements will be carried out at the same positions in order to describe the seasonal cycle in the mass-field and associated (iso- diapycnal) property-fluxes in each basin. Resulting data will be, among other things, used for the estimation of geostrophic motions in deep layers and associated volume transports as well as for the setup of numerical circulation models.

The area of investigations is shown in Fig.1. CTD- measurements have been performed with the SeaBird System from the sea surface to the near bottom layer. The station spacing was 2.5 n.m. on a regular station grid, which covers the area between (55°- 55°35') N, (15° 20.7'- 16°26.2') E. This map also indicates selected depth contours.

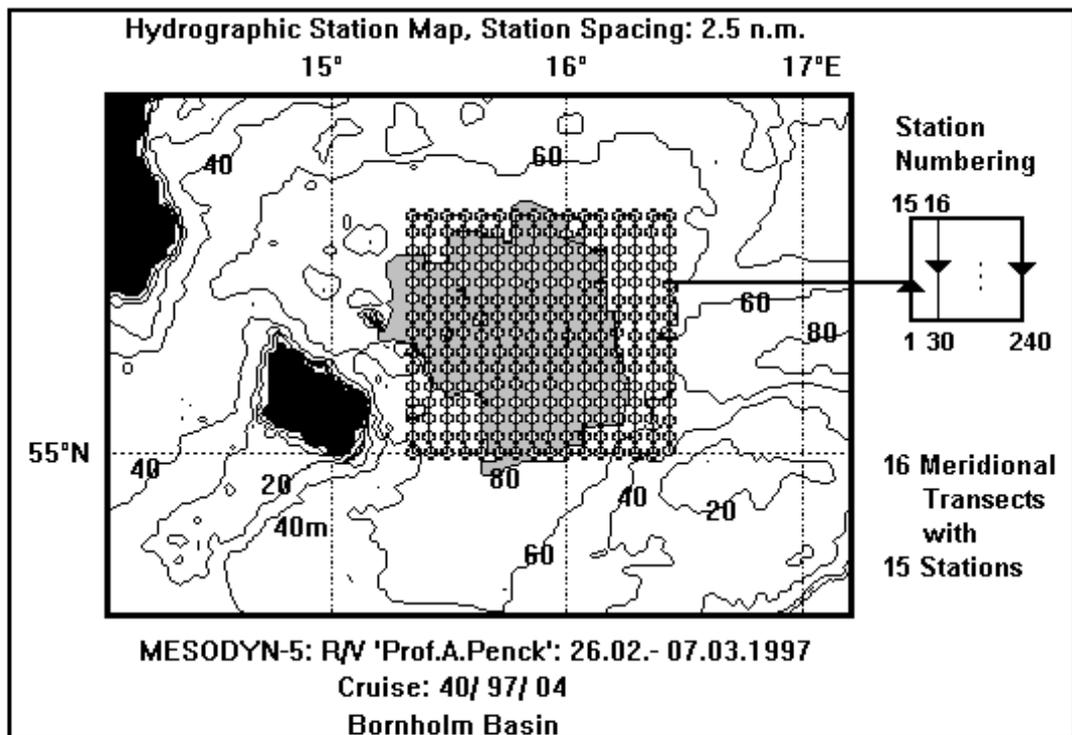


Fig.1. Area under investigation

A total of (16 transects x 15 stations) 240 vertical CTDO -profiles was gathered. The temperature was controlled by three reversing thermometers at different depths twice a day. The resulting rms error is +/-0.001 K without any statistical correlation with the pressure. An analogous procedure was performed for salinity with the aid of salinometer measurements and dissolved oxygen resulting from bottle casts of the same horizons. Its largest rms values are found to be +/-0.3 ml/l of dissolved oxygen.

All profiles were sampled during winds from W - SW with velocities in the range of (8 - 18) m/s. The top layer was well mixed down to about 45 dbar. Its temperature was about 2.5-2.9°C with salinities between 7.3 and 7.7 PSU within the range of the density maximum. Associated values of dissolved

oxygen changed between 7.5- 7.7 ml/l. In the near bottom layer, the salinity reached values near 18 PSU.

In order to check the 'steady state' in the observed mass-field, an additional transect was carried out along 55°10'N from east to west (no.241-256). No significant changes could be detected with respect to the inclination of the main halocline between the resulting quasi-synoptic transect and that compiled from the 16 meridional sections. For instance, the pressure level of the 12 PSU surface well describes the horizon of the halocline.

Along the south-west flank of the basin, water of near bottom layers locally formed dome-shape patterns reaching up to the horizon of about 45 dbar while the halocline was deeper than the level of 60 dbar along the north-east flank of the basin. In layers beneath the pycnocline, strong baroclinic pressure gradients occurred with an orientation from south-west to north-east and suggest a baroclinic inflow into the basin from north-east to south-west. This geostrophic inflow forms a cyclonic circulation pattern on the basin scale. That conclusion is supported by the mapped temperature at the pressure level of 60 dbar. A centre of relative warm (8°C)- saline (14.5 PSU) water with low oxygen content (3 ml/l) took place above the deepest part of the basin. That suggests upwards directed net motions. However, closed isotherms (6°C) also indicate relatively cold water patches on the meso-scale. Their diameters are in the range of about 5 - 40 km and essentially extend the scale of the internal radius of deformation. Trapped water is relatively poor in salinity and oxygen. That observation corresponds to downward motions. It seems to be that these features 'travel' around the basin and follow the cyclonic circulation pattern of the basin scale. However, this conclusion must be documented by other observational strategies (drifters and/ or moored current meters).

E. Hagen  
Chief scientist