

***Black Sea Ecosystem Recovery Project***

***International Science Group***

***BSERP-3 cruise***

***R/V "Akademik" (8-19 May 2004)***

# ***Final Cruise Report***

***2 October 2004***

***Prepared by Prof G.I.Shapiro, Chief Scientist***

***Approved by Prof L.D.Mee, Chairman of the BSERP  
International Science Group***

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***Part I: Chief Scientist Report***

## ***Black Sea Ecosystem Recovery Project***

### ***BSERP-3 cruise , R/V “Akademik” (8-19 May 2004)***

#### ***Part I: Chief Scientist Final Cruise Report***

##### **0 Introduction**

The Black Sea is a natural inland water basin situated between Europe and Asia, with a population of about 16 million people inhabiting the coastal zones of six countries. The Black Sea receives river inputs from a large catchment territory, including major parts from seventeen countries and large European rivers such as the Danube, the Dnieper and the Don. The sea is connected to the Mediterranean only through the narrow and winding, 35-km long Bosphorus Strait. There is little chance for toxic materials and pollution to escape from the Black Sea, and this is why the Black Sea is confronted with many environmental problems. The most significant of these is massive over-fertilization – largely from agricultural, domestic and industrial pollution – leading to excessive growth of algae and oxygen depletion. Other problems include pollution by oil spills, overfishing, and the introduction of exotic species.

##### **1 Cruise Outline**

The cruise BSERP-3 constitutes the second leg of the May-2004 observational field campaign onboard R/V Akademik. The whole campaign started on May, 3rd in Varna (Bulgaria) and finished on May, 19 in Sevastopol (Ukraine). The first leg finished on May, 8<sup>th</sup> in Sevastopol, where the scientific staff involved in the first leg disembarked, and replacement scientific staff and equipment was loaded. BSERP-3 cruise departed from Sevastopol on May 8<sup>th</sup>. Sampling activities were carried out from May 9<sup>th</sup> to 18<sup>th</sup>. The ship arrived in Sevastopol on 19 May 2004.

The research cruise was contracted by the Black Sea Ecosystem Recover (BSERP) Project Implementation Unit (Istanbul) and funded by the Global Environment Facility. The scientific crew of the BSERP-3 cruise represented 3 countries , whci participate in the BSERP project.

The specific objectives of the cruise are:

- To test the prospects of new equipment for the goals of the BSERP
- To quantify shelf- deep sea transport of water masses and exchanges of nutrients by mesoscale activity at the North West Black Sea shelf break

The scientific program was run by Chief Scientist Professor Georgy Shapiro (University of Plymouth, UK). The ship sailed under command of captain Dimitrov, Zhelyazko Angelov (Bulgaria).



Fig1. Research vessel Akademik (Bulgaria) , photo by G.Shapiro

## 2 Testing equipment



Fig2. Lowered Acoustic Doppler Current Profiler (photo by G.Shapiro)



Fig.3 Fast Rate Repetition Fluorimeter (photo by G.Shapiro)

Two pieces of advanced modern equipment, which have never been used before in the Black Sea, were tested during the cruise (see Fig.2 and Fig.3)

### 3 Sampling sites and Coordinates

Following the outcome of discussions run by the International Science Group of the BSERP project, the monitoring strategy for the cruise was based on the Lagrangean approach, so that the actual area of study could only be identified a few days before the cruise within the larger “area of interest”, which is shown in Fig 4.

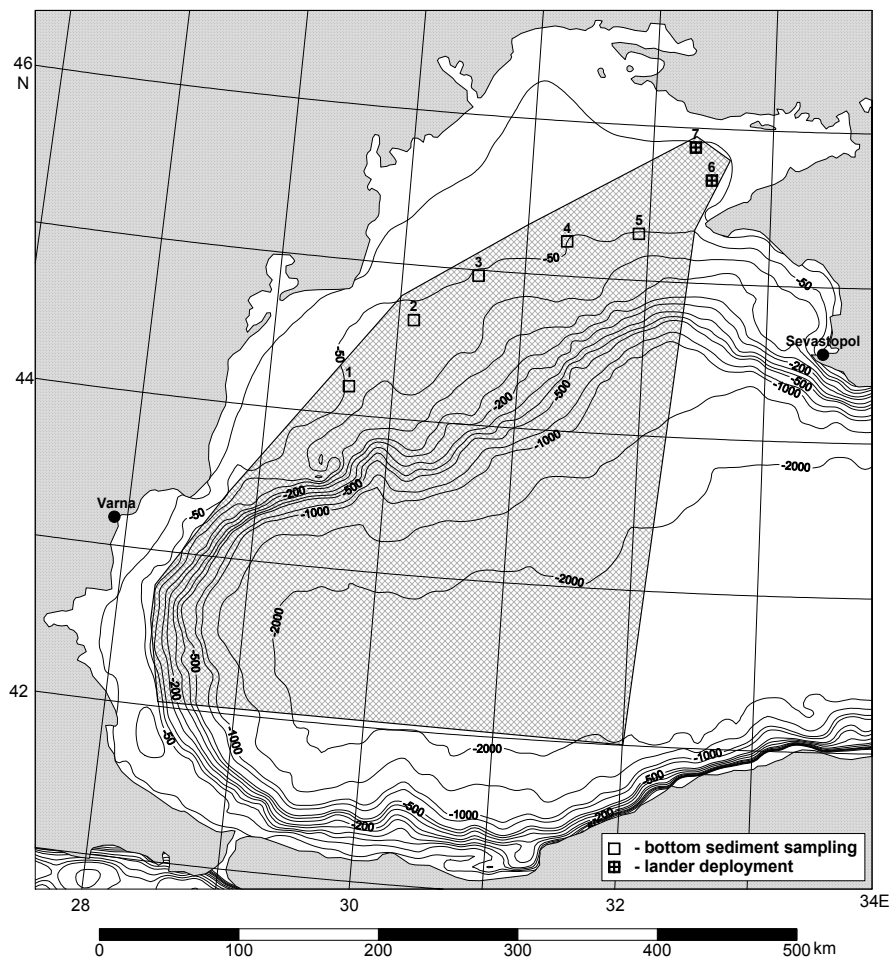


Fig.4 area of interest (shaded area), Graph prepared by V.Ivanov

Provisional location of an intensive meso-scale eddy was identified using satellite image of Sea Surface Temperature obtained from a NOAA satellite on the 7 May and provided by Dmitry Soloviev (MHI) as shown in Fig.5. The study area was selected to cover the eddy and adjacent regions.

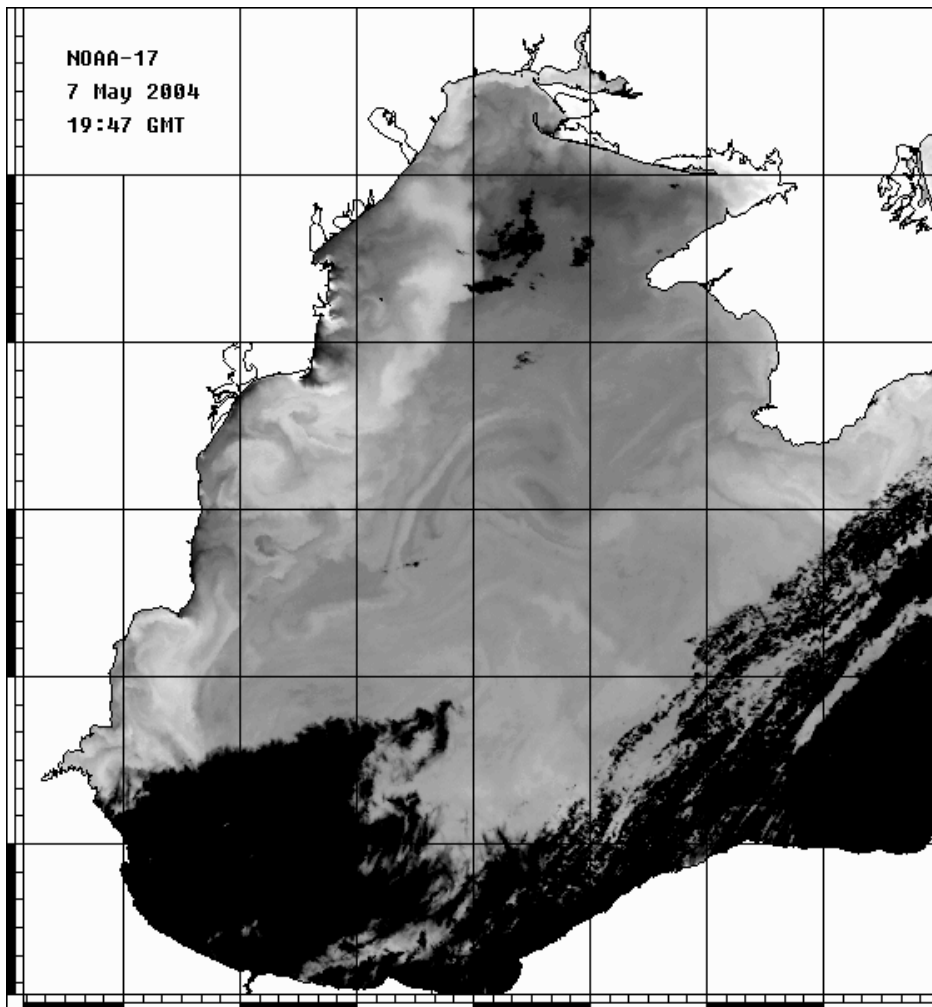


Fig.5 Sea Surface Temperature on 7 May 2004 ( by D Soloviev, MHI)

The final selection of sampling sites for the first transect ( sts 1-10) was made by the Chief Scientist onboard the ship using the satellite image shown in Fig.6. The selection was based on the application of Lagrangean strategy for sampling, which assumes that the sampling sites follow the water flow. This strategy was specifically developed for the BSERP-3 cruise in the University of Plymouth.

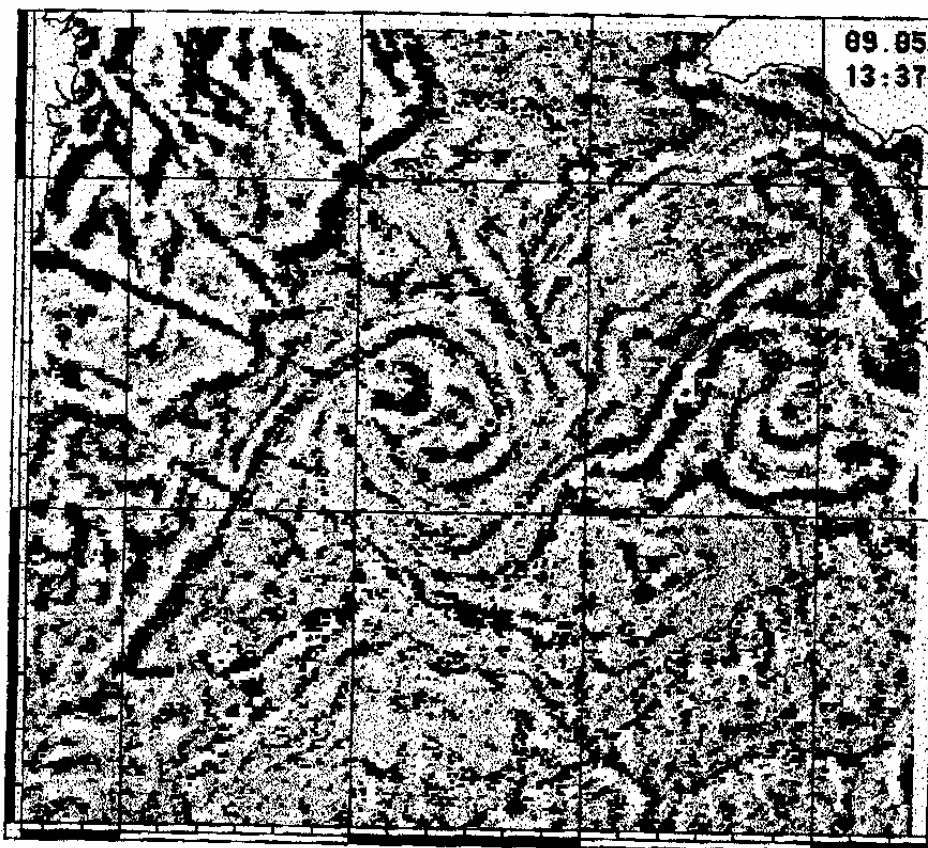


Fig.6. SST image on 09 May 2004 after being processed by a gradient filter on land by S.Stanychny and his group (MHI) and received onboard R/V Akademik on 10 May 2004 by fax.

Locations of further transects and individual sampling sites were identified daily using satellite images and data from CTD profiles which were obtained onboard within few minutes after the completion of the stations. Due to weather restrictions, only 2 satellite images were available during the cruise as shown in Figs 6 and 7.



Fig.7. Same as Fig 6 but for 12 May 2004.

The original plan was to make 4 series of 2 swift cross sections through the eddy and surroundings to make a shape of “butterfly wings” , which is deemed to be most suitable for Lagrangean studies. Owing to stormy weather conditions the sampling was interrupted twice , after St 19 and St 34. The ship was hiding in the Laspy bay (after st 19) and on the North Western shelf (after St 34) at the location of st 35. Location of the surface signature of the eddy was corrected using the last availble satellite image of 12 May 2004, see Fig.7

The final station grid was determined by Chief Scientist using all available data both obtained remotely and in-situ onboard the ship (SST from NOAA satellite, currents from ADCP casts, 3-D temperature salinity structure from CTD casts, ship drift from Global Positioning System data). The map of sampling sites is shown in Fig.8

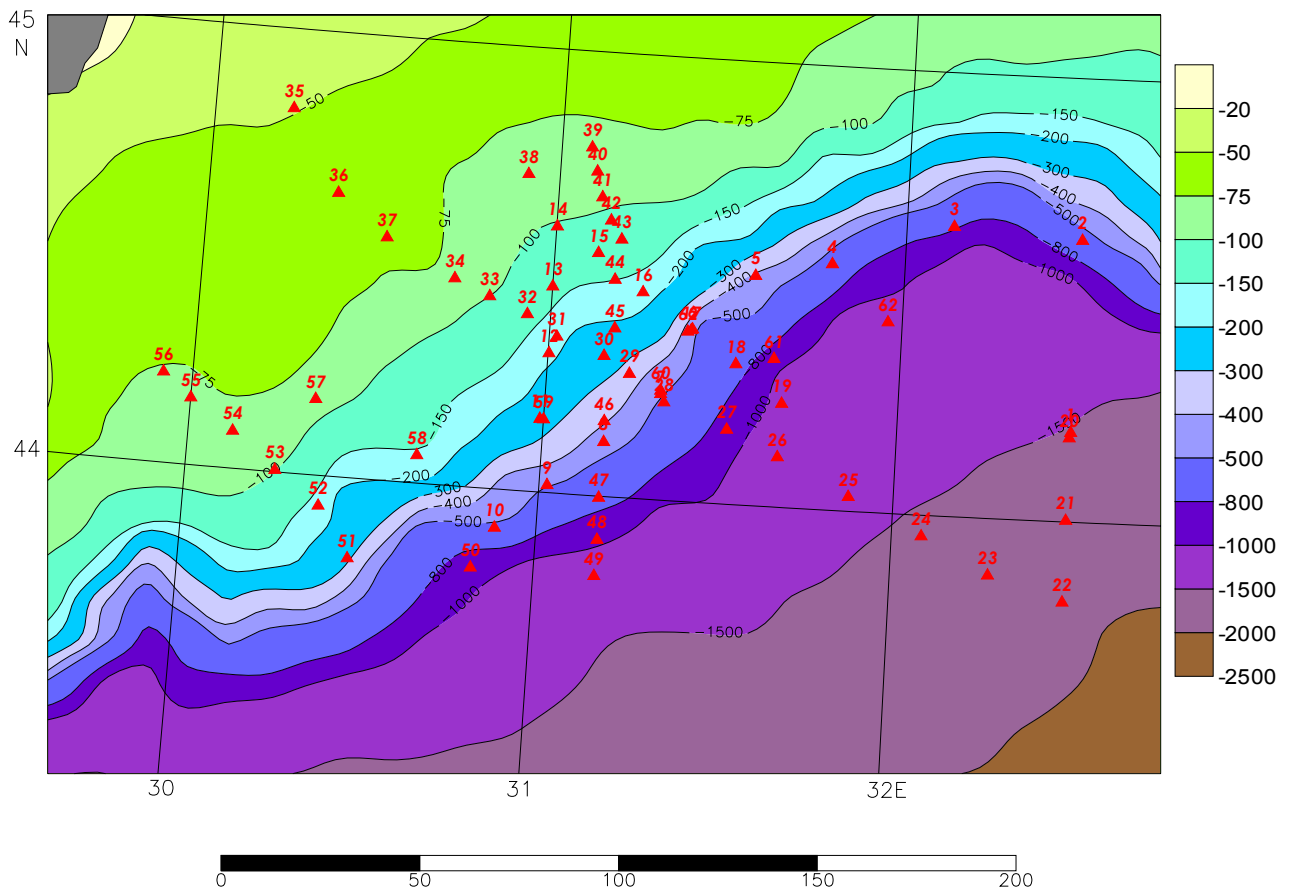


Fig.8. Location of stations for BSERP-3 cruise.

#### **4 Sampling Activities**

The measurements were concerned with the properties of upper and benthic boundary layers with supporting sampling in the water interior. All measurements were taken while the ship was in drift. A total number of 62 stations were occupied, of which:

- 62 stations with CTD profiling of temperature and salinity of sea water;
- 62 stations with current velocity measurements using Lowered Acoustic Doppler Current Profiler (LADCP);
- 38 stations with water sampling for chemical analysis (from Rosetta bottles);
- 20 stations with Fast Rate Repetition Fluorimeter (FRRF) profiling;
- 16 stations (some with multiple deployment of equipment) with CTDV-Sigma profiler (measurements of turbulence);
- Launch of 6 surface ARGOS drifters (a cluster of 3 and a further 3 on a transect)

The ship track was continuously recorded using research GPS facilities.

Additionally 2 satellite images of the study area were obtained by an MHI land-based receiving station, and faxed onto ship.

Brief description of the sampling activity is given below. More details including description of methodology and instrumentation can be found in the group reports (attached).

## CTD measurements

Temperature and salinity measurements were carried out using SBE-911PLUS probe by SeaBird Electronics (SBE), which also included a 12 bottle carousel for water sample taking for chemical analysis. Profiling was taken down to 1000m maximum and water samples were taken at the prescribed depth levels during the upcast.

Examples of temperature, salinity and density profiles are shown in Fig.9

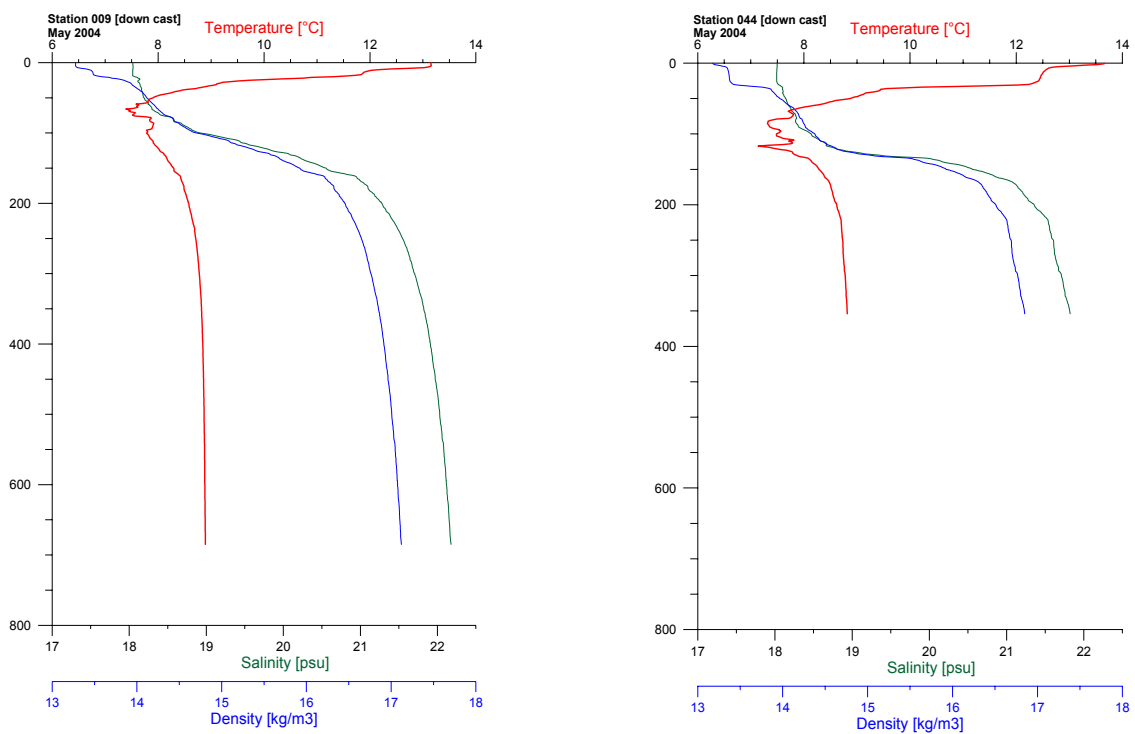


Fig.9 Example profiles of temperature, salinity, density (graphs prepared by D.L.Aleynik, Plymouth)

## Chemical measurements

The main task of the biochemical investigation in the cruise was the detection of features of vertical and spatial distribution of oxygen, hydrogen sulfide and nutrient elements in the anticyclone and hydrochemical structure of the shelf region adjacent to the shelf slope during spring time.

The following equipment was used. High precision piston burette Metrohm 765, # 04104 was used for oxygen and hydrogen sulfide volumetric determination. Two Photoelectric spectrophotometers KFK-3 # 9108218 and 9110973 were used for spectrophotometric determination of phosphates, silicic acid and nitrites. Autoanalyzer AA II, Bran+Luebbe will be used for the determination of nitrates in collected samples in a shore laboratory. High precision dispenser was used for adding of iodine solution into the 200 ml volumetric flasks for the hydrogen sulfide determination. Calibrated 100-ml oxygen flasks were used for the determination of dissolved oxygen. Barnstead Repipette Dispensers were used for dosing of pickling reagents into the oxygen flasks during sampling procedure.

Calibration curves show the high quality of chemical measurements.

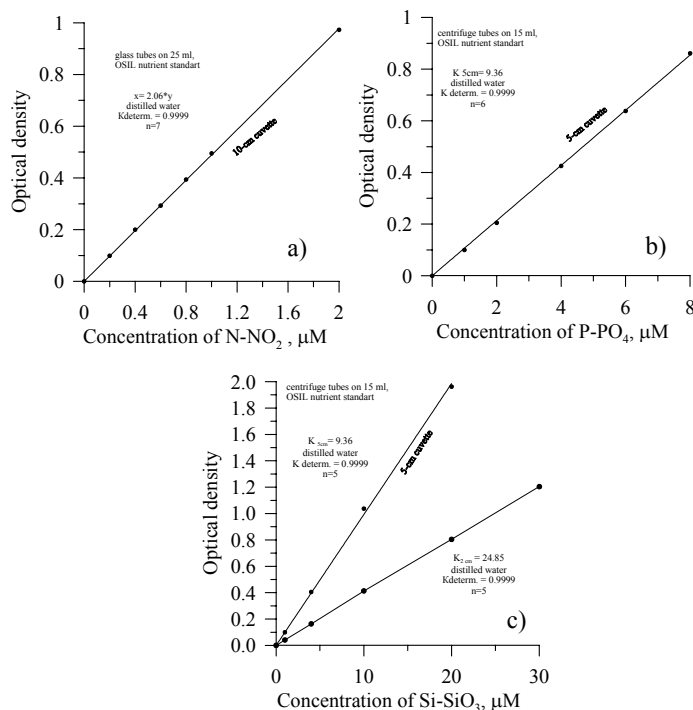


Fig. 10. Calibration curves for nitrites (a), phosphates (b) and silicates (c) made during the cruise by using OSIL nutrient standards (by A.S. Romanov, MHI).

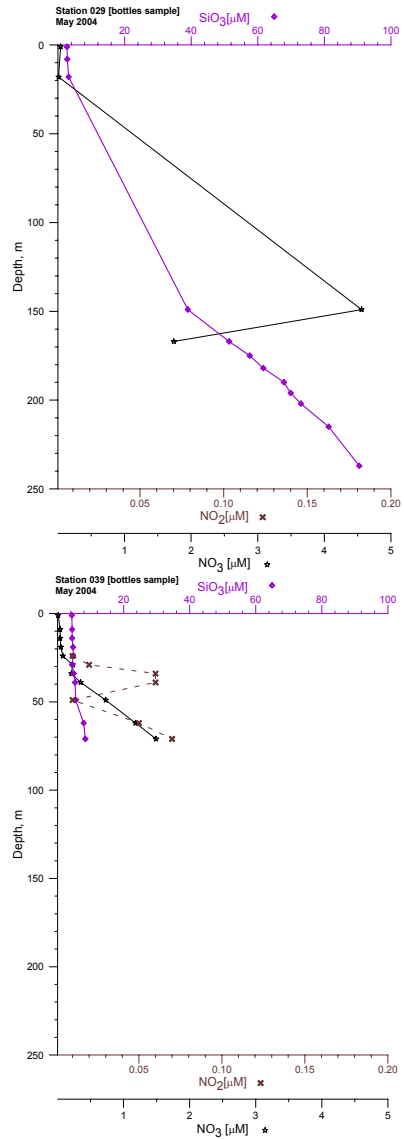
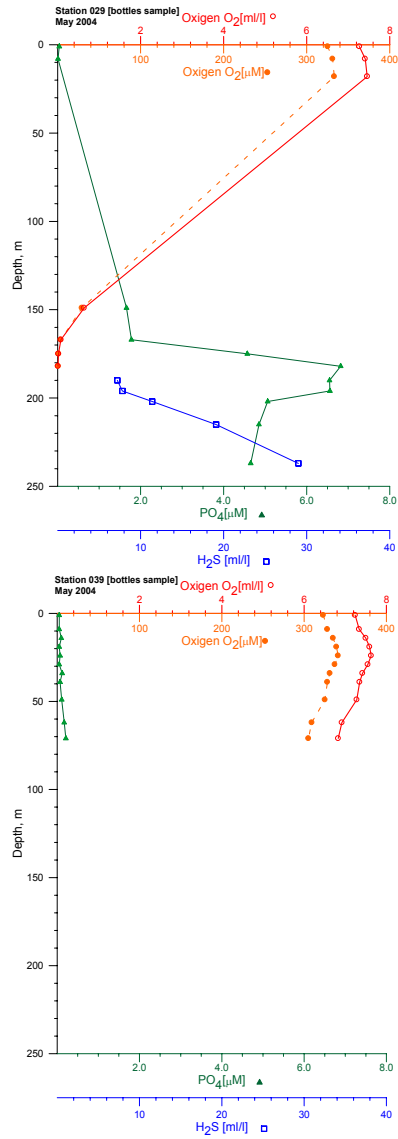


Fig.11 Examples of the vertical profiles of chemical substances (graph prepared by D.L.Aleynik)

## Current meter measurements

The equipment used was the Lowered Acoustic Doppler Current Profiler (LADCP), manufactured by RDI, Model WHM300-I-UG23, Serial Number 4253. The equipment was purchased on advice from the University of Plymouth staff (Dr A.Nimmo Smith), who identified the best specification for the Black sea conditions. The software used to obtain the velocity profile included bundled software by RDI and a specialist software package developed by Martin Visbeck (Lamont-Doherty Earth Observatory , University of Columbia, USA).

Training and advice to the members of Marine Hydrophysical Institute were provided shortly before the cruise by V.Ivanov and A. Nimmo Smith (both UoP)

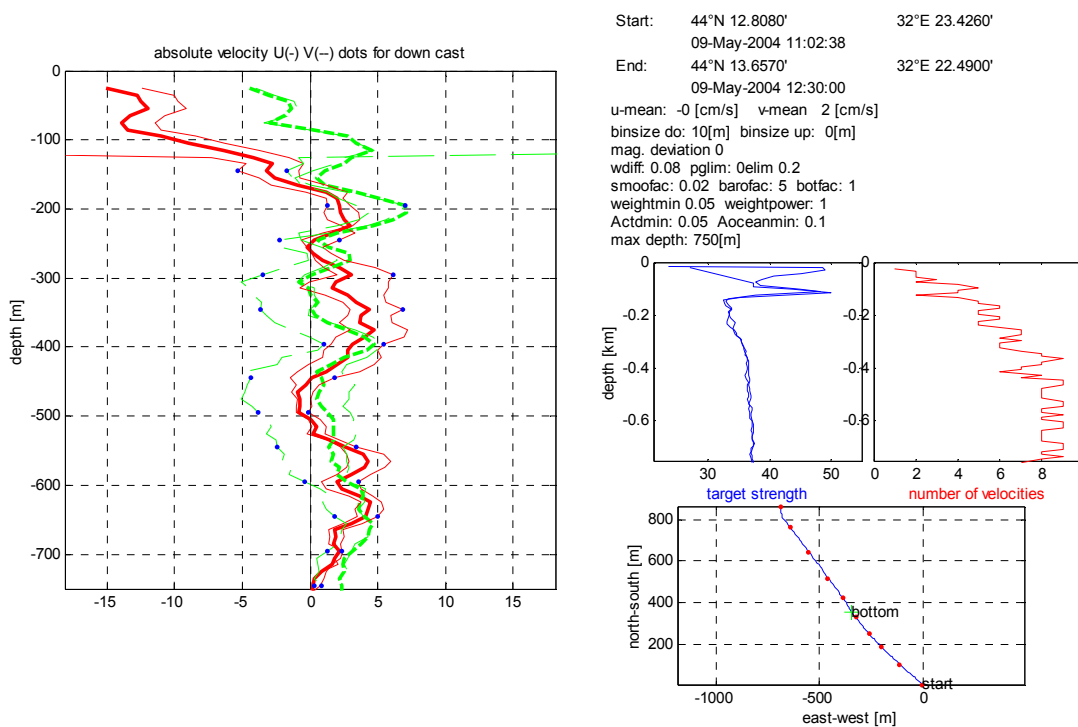


Fig.12 Example velocity profile from LADCP as produced by M.Visbeck's software (graph prepared by A.Morozov, MHI)

## Drifters

A limited number of 6 surfer Argos drifters was purchased to be launched during the cruise and provide data on water motion, sea surface temperature and atmospheric pressure after the cruise has been completed. In order to obtain most useful information a special strategy of drifter deployment was developed in the University of Plymouth. This strategy includes the use of a cluster of 3 drifters in the eddy core to study dispersion and a transect of 4 drifters across the radius of the eddy to study the transport properties. The advantage was that it was possible to use only 6 (not 7) drifters for this strategy as one of the 'cluster' drifter was part of the 'transect' at the same time. Fig 13 shows the drifters trajectory as of 07 September 2004.

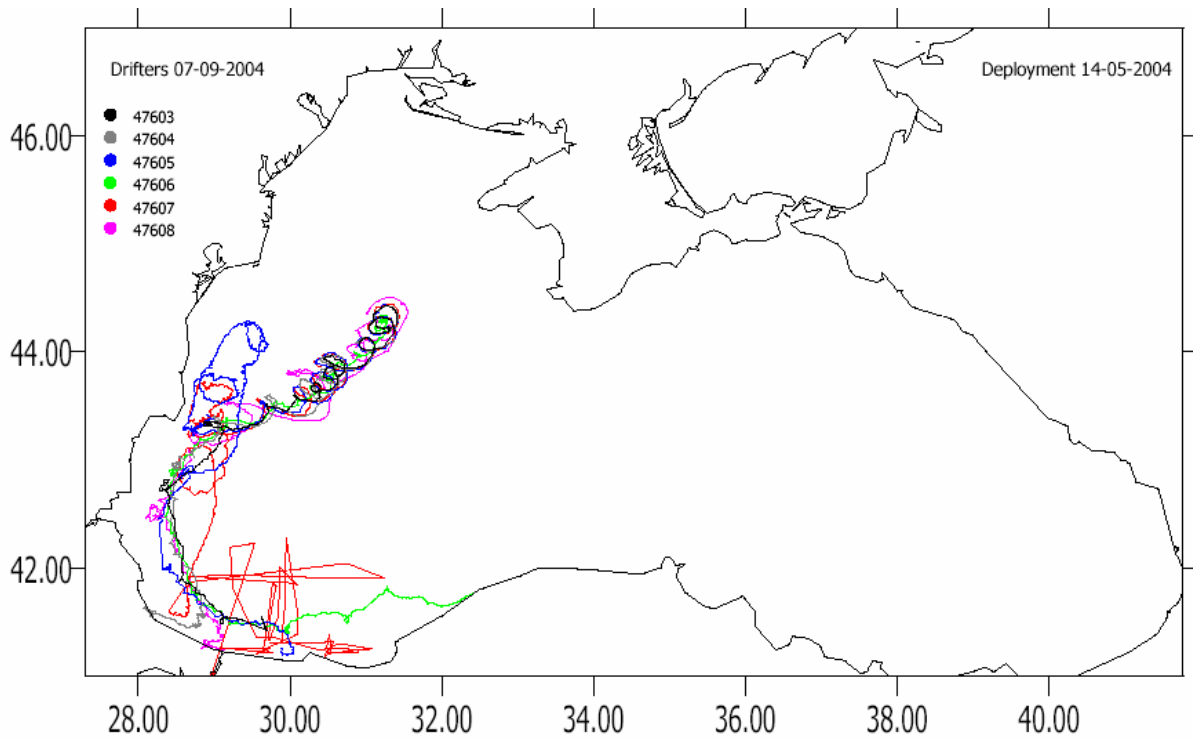
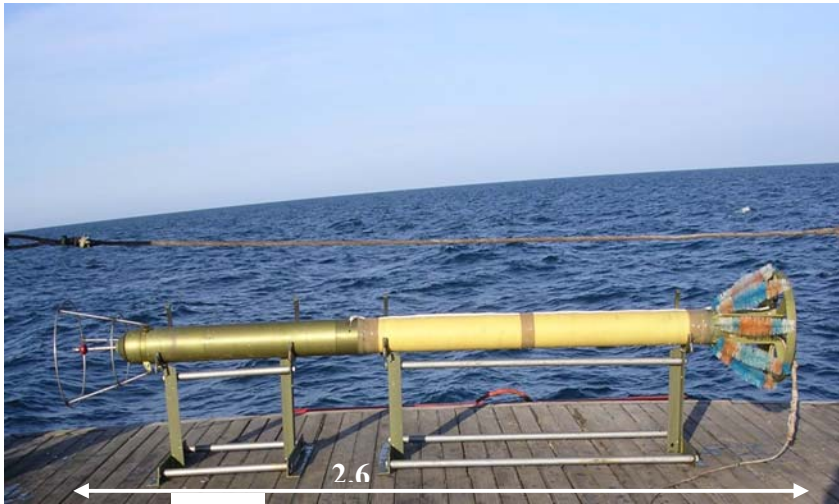


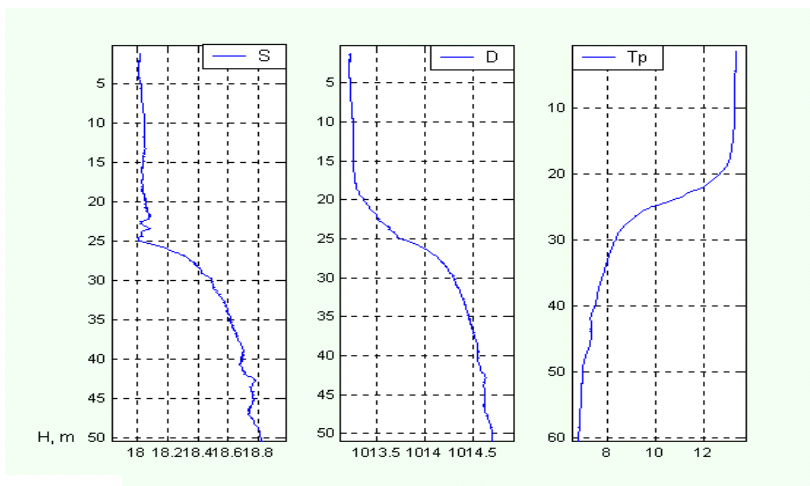
Fig.13. Drifters tracks on 07 September 2004 (provided by E.Lemeshko)

## Turbulence

The experimental data collection of about a fine structure of fields of a current velocity, temperature and electrical conductivity in a northwest part of the Black sea realized with a help of a falling probe - measuring complex "Sigma-1" down to the depth of 100 m.



Measuring complex "Sigma-1"



. Profiles of salinity, density and temperature

Fig. 14 Provided by A.S. Samodurov (MHI)

## 5 List of Participating Scientists

Name	Institution	Country	Responsibility
SHAPIRO Georgy	University of Plymouth, UK	Russia	Chief scientist (07-20.05), LADCP data analysis
IVANOV, Vladimir			Deputy Chief Scientist, LADCP data processing
LEMESHKO, Yevgen	MHI, Sevastopol	Ukraine	Deputy chief scientist, LADCP measurements
MOROZOV, Olexsiy			Current group leader, LADCP measurements
ZIMA, Viktor			Hydrology group leader, CTD-measurements
DREMOUH, Anatoliy			CTD-measurements
LIPOVECKIY, Sergey			CTD-measurements
GORYACHKIN, Yuri			Duty research officer, CTD-measurements
LISICHENOK, Olexandr			Duty research officer, CTD-measurements
LUNEV, Yevgen			LADCP measurements, drifter launch
ROMANOV, Olexandr			Bio-Chemistry group leader
KONDRATIEV, Sergey			Bio-Chemistry measurements
VNUKOV, Yuri			Bio-Chemistry measurements
CHUMAKOVA, Nataliya			Bio-Chemistry measurements
ZUBOV, Anatoliy			Turbulence measurements
DYKMAN, Volodimir			Turbulence group leader
BARABASH, Valeriy			Turbulence measurements
STANCHEV, Hristo	Institute of Oceanology, Varna	Bulgaria	Fast Repetition Rate Fluorimeter



Fig. 15 Participants of BSERP-3 cruise

Sampling schedule, final reports by research groups, and primary data are attached.

Chief Scientist,

Professor Georgy Shapiro  
02 October 2004