RESEARCHES ON THE NORTH-WESTERN BLACK SEA CARRIED OUT BY ROMANIAN CENTRE OF MARINE GEOLOGY AND GEOECOLOGY DURING 1995 WITHIN THE EROS 2000 PROJECT

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Abstract: The paper presents the activity of the Romanian team during the second leg of the EROS 2000 Black Sea cruise on board of R/V "Prof. Vodyanitskyi" (4-28 August 1995), being in fact a cruise preliminary report.

Introduction

As known, the Black Sea has a catchment area of more than 2 million Km^2. The total riverine water input represents about 390 Km^3, while the sediment discharge is ca. 150 million tons per year, with the bulk occurring in the north-western part of the sea.

In the last three-four decenies the river water and sediment discharge into the NW Black Sea have experienced an important decrease due to the construction of dams and barrage lakes. For example, the sediment discharge of the River Danube has decreased by 30-40 % with the construction of the Iron Gates dams. The average reduction in the water discharge of the Dniepr, Dniestr and Don rivers is 70, 60 and 40 % respectively. The present day average sediment discharge of the River Danube is estimated at ca. 40-50 million tons per year, out of which 5-8 million tons/year sandy material. The Ukrainian rivers (Dniepr, Dniestr and Southern Bug) provide additional 5 - 7 million tons of sediments per year.

The dispersal and distribution of river born material (sediments, organic and inorganic pollutants etc.) in the Black Sea is controlled by numerous factors as physiography, current local and general patterns, anthropic activities etc.

At the same time, the Black Sea represents the largest anoxic reservoir in the world, where methane, dimethyl sulphide and nitrous oxide, as well as the hydrogen sulphide are actively produced. The mentioned gases may contribute significantly to the green-house effect with a strong environmental impact.

Due to its unique characteristics, the Black Sea is an area particularly sensitive to climate change, eutrophication and hydrological regime modifications and represents a region where the successive events leading to severe damages of ecosystems can be identified and understood.

Identification and understanding of the structure and functioning of the Black Sea ecosystems, of sources and fluxes of pollutants and vital important elements and particulate matter, as well as of the ecosystems responses to the ecological stress would provide basic knowledge for optimising the measures for stopping the negative evolution and ecological recovering of the ecosystems.

EROS is an interdisciplinary long-term research project on biogeochemical processes at the land-sea interface of contrasted European coastal seas having as objectives the understanding and prediction of their alteration by human activity and the determination of their contribution to global changes.

Initiated as a reaction of the scientific world to the increasingly dramatic ecological situation of the Black Sea, the world's largest anoxic basin, with unique characteristics, where methane and hydrogen sulphide are actively produced, EROS 21 - the Black Sea component of EROS 2000 - has to answer to four key questions, determining the structure of the project:

1. What would be the consequences of a reduction of the river input of nutrients for the eutrophication and the ecosystem structure of the north-western Black Sea?
2. What are the riverine and atmospheric sources, levels and fates of key organic/inorganic pollutants in the Black Sea environment?
3. What are likely to be the short- and long-term consequences of the regulation of river discharge for sediment erosion/transport/deposition, water stratification and the
location and the thickness of the redoxcline (sub-oxic layer)?

4. What is the significance of the Black Sea as a source of important key greenhouse gases?

To answer these questions the project associates several EROS groups belonging to the EU with counterpart participants from Russia, Ukraine, Romania and Bulgaria. Each question is adressed by a separate sub-project, mutually interactive with the others and including several specific tasks. The four resulting sub-projects are the following:

- eutrophication;
- contamination
- river discharge, reservoir sedimentation and sediment transfer;
- biogases

Objectives

Within this general framework the following main objectives have been defined for the second leg of the EROS 1995 Black Sea cruise:

1. General assessment of the bottom sediments, of the meio and macrobenthos as well as of the macrozooplankton in the NW Black Sea in order:

- to determine the bulk constituents of sediments as carbonate, biotic silica, lithic matter, bulk C, N, P and S etc.;
- to establish the past and the present day environmental changes by determining the fauna (molluscs, foraminifera, ostracodes etc.) content and specific constitution in the sediments;
- to identify the sources and the pathways of terrigenous and organic particles and associated pollutants;
- to establish the patterns of particles and pollutants dispersal and deposition over the continental shelf and slope, as well as in the deep sea zone;
- to measure the rates of sedimentation using ^{210}Pb and gamma emitters associated with the atmospheric fallouts from different atomic tests or accidents;
- to identify the presence of terrigenous versus marine organic matter in the water column and superficial sediments;
- to measure the fluxes of oxygen, nutrients etc. at the water/sediment interface;
- to evaluate the present day cantitative and qualitative state of bottom and pelagic (mostly jellyfish Mnemiopsis) organisms and to establish their role in biosedimentation processes.

2. Assessment of sediment fluxes, their seasonal and interannual variability and water-column transformation of particulate material.

3. General assessment of Biogases in the Black Sea by:

- mapping the gas-seeps locations;
- studying the gas-seeps constituents;
- determining the gas content in sediments and water column;
- measuring the biogeochemical production and oxidizing processes of biogases, as well as the gas flux at the water/sediment interface.

For reaching the above described objectives an international team participated (see Appendix 1).

The main objectives of the Romanian team were defined such as follows:

a) Study of sediments :

- detailed observation and description;
- grain size analyses;
- mineralogy of clay and heavy minerals;
- chemistry: bulk constituents, heavy metals, TOC
- radioactivity;
- magnetic susceptibility.

b) Assessment of macro and meiobenthos: specific determination, statistics and density of appearance, ecological state.

c) Assessment of macrozooplankton, mainly of jellyfish distribution and size characteristics.

d) Assessment of old faunal assemblages - molluscs, foraminifera, ostracodes etc., as index of marine paleo-environmental characteristics;

e) Gas seeps mapping and studying;

f) General evaluation of ecological state of the north-western Black Sea, mainly of the pollution of sediments and benthos.

Preliminary results

a) Sampling, sediment description and faunistic determinations

For all the 33 stations (Fig. 1) detailed description of the sediment cores were performed. As an example, the detailed description of the Station BS-23 sediment core is presented (Fig. 2, 3; Tables 1, 2). Quantitative samples of zoobenthos have been taken in 30 stations, where observations and description of macrozoobenthos samples were registered. In addition, in each station macrozooplankton (jellyfish) was studied using a large plankton net, mostly in water surface layer (20-0 m).

In each station, 2-3 subsamples have been repeatedly taken so during the cruise more than

120 samples of zoobenthos (mostly meio- and microbenthos) have been preserved (in formaldehyde 4 % and Red of Congo) and will be sorted and studied in Constantza Laboratory. Some of the samples, analysed on board by Dutch and Swiss teams, have also been preserved for faunistical qualitative and quantitative determinations in RCMGG Laboratories. In addition, in each station sediments from superficial layers (3-4 cm thick) have been collected for measurements of radioactivity.

In each station 3-8 subsamples have been taken in order to be analysed for grain size, clay mineralogy, geochemistry etc.

b) Conclusions

1. During the leg 2 of the EROS "1995 Black Sea cruise", 33 stations for sediment and water assessment were carried out. The selection of stations locations took into consideration the covering of all 6 major depositional systems/zones of the north-western Black Sea (see also Table 3):
   - Danube Delta area - 8 stations (delta front area - 5 stations, prodelta area - 3 stations);
   - Danube deep-sea fan - 1 station;
   - Dnepr mouth zone and Odessa depression - 3 stations;
   - Dniestr mouth zone - 3 stations;
   - continental shelf area -14 stations (sediment starving continental shelf - 6 stations, area under the influence of the southward drift of Danube-borne sediments - 7 stations, area out of influence of rivers Danube, Dniestr and Dnepr - 1 station);
   - shelf break area, near the oxic/anoxic zone - 3 stations;
   - abyssal plane - 1 station.

2. In 1995 summer (August) within the NW Black Sea a striking scarcity of macrozoobenthos organisms has been recorded (Table 4, Table 5). Only 20 species were present in the collected samples and almost half of them were recorded only in one sample. The *Polychaeta* worm *Melinna palmata* has the largest bathymetrical distribution, being followed closely by the mollusc *Mytilus galloprovincialis*. The bivalve *Modiolus phaseolinus* with its cohabitants (*Sycon ciliatum* - sponge, *Caprella acanthifera* - crustacean amphipoda, *Calyptrea chinensis* - gastropoda, *Amphiura stepanovi* - echinodermata, *Eugyra adriatica* - ascidiacea) are restricted at dipper bottoms, descending down to the boundary of life in the Black Sea. Another group of species is limited to the shallower bottoms (*Mya arenaria, Cerastoderma edule lamarckii, Chione gallina, Tritia (Nassarius) reticulata* - molluscs; *Spionidae* - Polychaeta worms). The highest specific diversity have been met in the bathymetric zones of 60 - 70 m - 9 species, 50-60 m - 7 species and 20-30 - 8 species.

3. The scarcity of macrozoobenthic organisms in the NW Black Sea could be much better put in evidence by referring to the quantitative aspects of species appearance. Except *Mytilus, Melinna* and *Modiolus*, the other species have been found in very limited quantities, representing the lowest limit of abundance for the species survival or the beginning of their extinction.

4. In August 1995 within the NW Black Sea, anoxic and azoic zones as well as near anoxic ones with few Polychaeta worms have been recorded. These zones are situated either in shallow water bottom in front of the Dniestr and Dnepr mouth or in the deep water bottoms at 120-150 m depth. It is obvious that the ecological pressure from the continent or from the H_2S zone represent the main causes of appearance of new anoxic and azoic environment in the NW Black Sea.

5. Precarious state of macrozoobenthic organisms reflects the regressive evolution of the NW Black Sea ecosystems. A rather good state of Modiolus community, the extinction of mussel populations towards deeper bottoms or the existence of few Polychaeta worms in anoxic conditions are the immediate conclusions which will be completed with the results of laboratory analyses.

6. In August 1995 the gelatinous plankton was very abundant in the superficial layer (20-0 m) of NW Black Sea waters (Table 6); on average the densities and biomasses are 24 sps.m^3 - 38 g.m^{-3}, being dominated by the populations of the new immigrant into the Black Sea, *Mnemiopsis*.

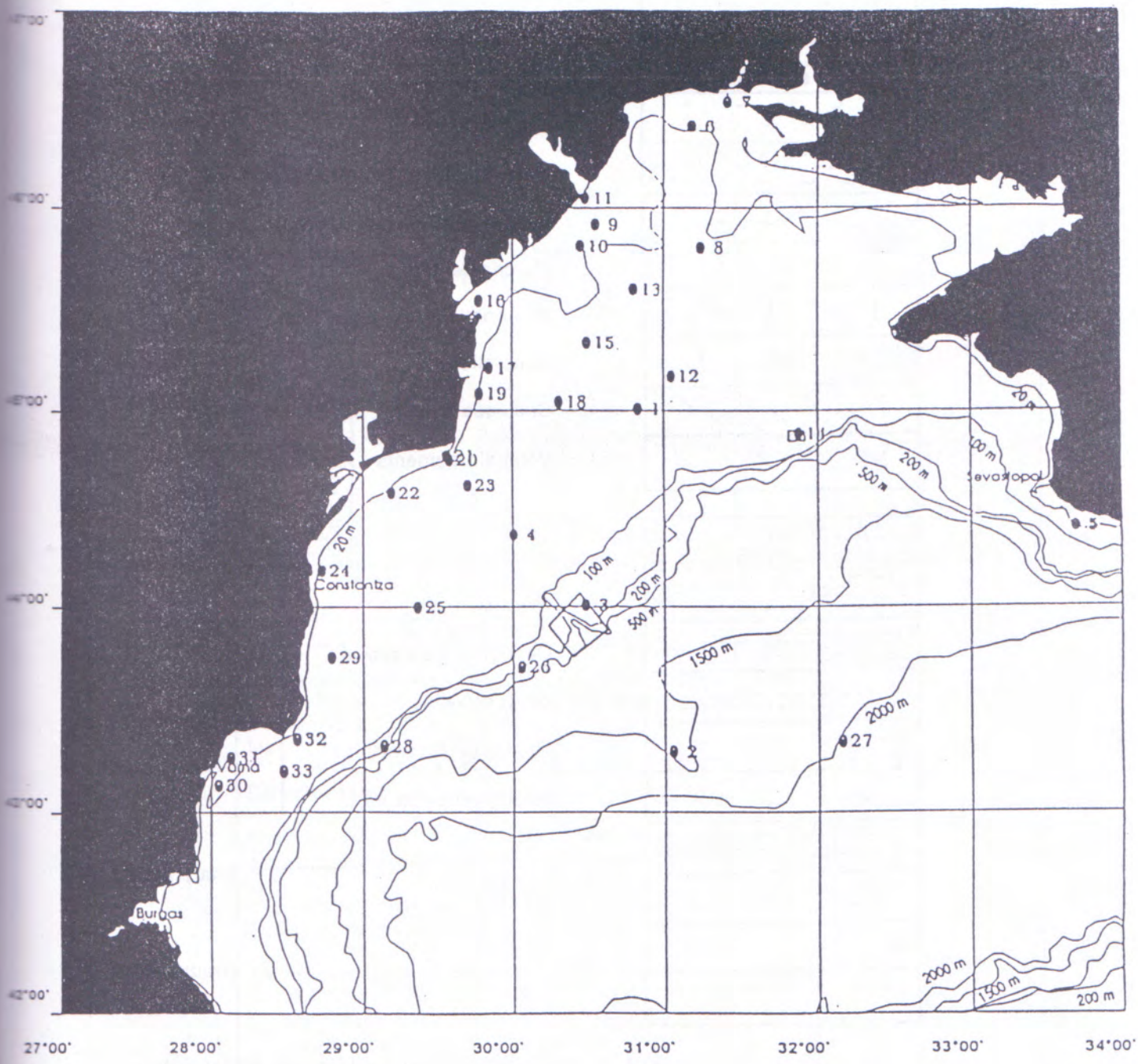
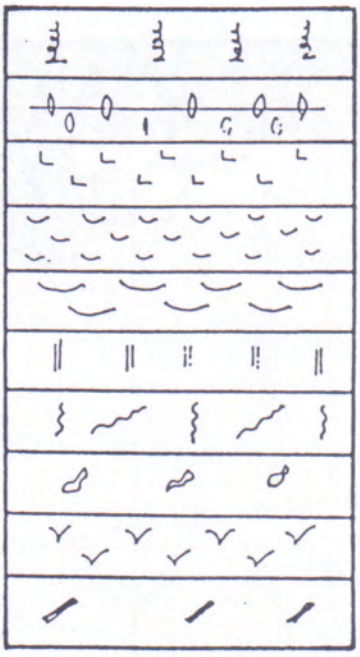


Fig.1 - The map of research area. EROS-2000 BLACK SEA 1995 Cruise, Leg 2
Localisation of the stations



Algae

Living molluscs

Shell debris

Small shells (usually *Modiolus, Cardiidae*)

Large shells (usually *Mytilus*)

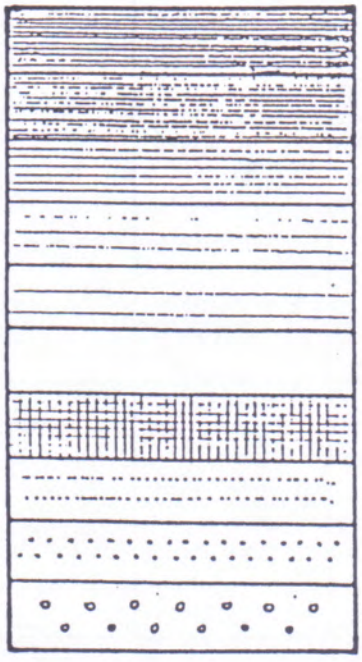
Polichaeta tubes

Bioturbations

Concretions

Chitinous material, fish bones

Vegetal fragments



Black

Blackish

Dark grey, dark brown

Grey, brown

Light grey, brownish

White, yellowish

Mud

Clay

Silt

Sand

Gravel

Sharp limit

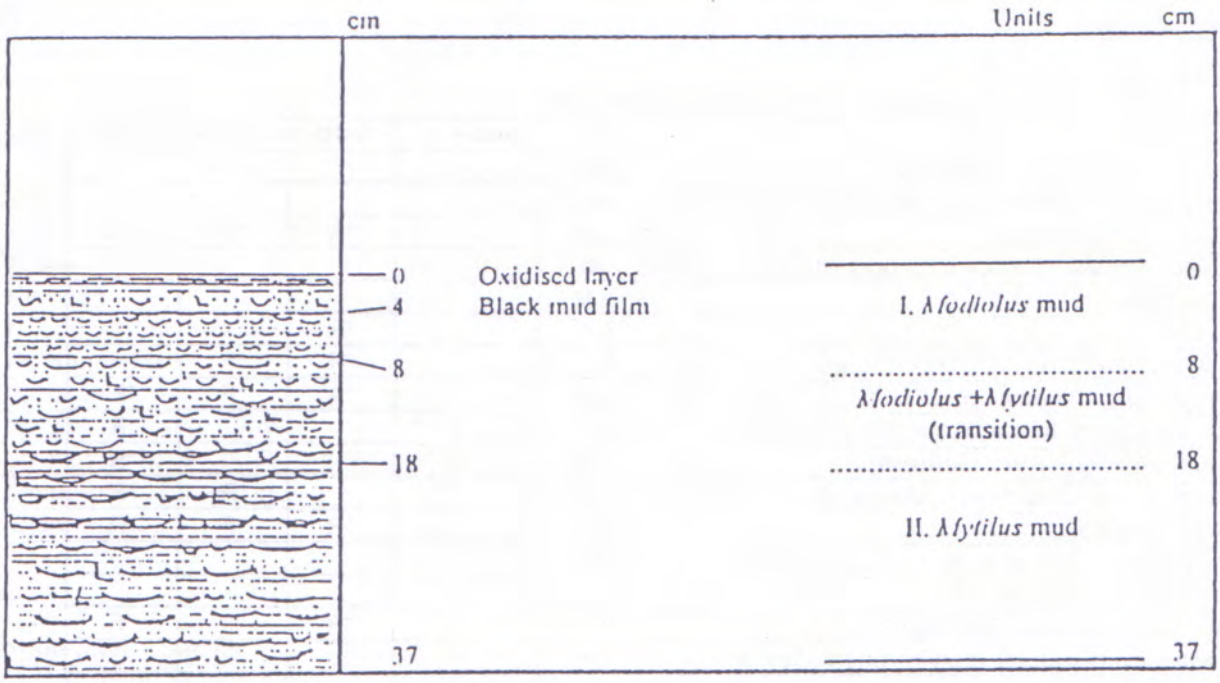
Gradual limit

Observations: 1. The term "unit" is used to indicate various lithologic and/or biologic separations within the box-corer sample. It may have regional value, sometimes.

2. For more precise information, lists of biologic content of the samples are included for certain stations.

Fig.2 - Key for the description of the box-corer samples.

EROS - 2000 BLACK SEA CRUISE - 1995, LEG 2		
R/V "Prof. Vodyanitskiy"	Sampling equipment: Box corer	Station No. BS-23
Date: August 20, 1995	Latitude: 44 37,3271 Longitude: 29 42,0474	Depth: 50m



Depth (cm)	DESCRIPTION	Samples
0-2	Light grey,, noncohesive (fluffy), silty mud containing a thin (<0.5 cm) layer of black mud within the uppermost part, overlaid by a thin (<0.5 cm) grey-yellowish (oxidised) mud on top.	
2-4	Dark grey sandy mud with few shells and shell debris.	
4-8	Shell deposit with grey muddy-sandy matrix, very rich in *Modiolus* (dominant), *Cardiidae*, *Mytilus* and shell debris.	
8-18	Grey silty to fine sandy mud, very rich in shells, dominated by *Mytilus*, *Cardiidae* and some *Modiolus*.	
18-37	Dark grey silty mud, very rich in shells with *Mytilus* dominant and H_2S smell.	

Observation: For more precise informations concerning the biologic content, see the joined list

Description by RCMGG

Fig.3 - Example of box-corer samples description - Station BS-23.

Table 1: Example of samples description - BS 23 (Molluscs)

Station BS-23

Molluscs

Sp.	Abreviations	Sampling interval (cm) Living sp.	0-10	10-20	20-40
Abra alba occitanica (Recluz)	aba				
Abra nitida milachewiichi (Nevesskaia)	abr				
Abra ovata (Philippi)	abo		*A	*A	*A
Acanthocardia (Cardium) paucicostata (Sowerby)	cap				
Adacnidae	ada				
Balcis	bal		*R		
Bittium reticulatum (Costa)	bit		*R	*F	*A
Calyptraea chinensis (L.)	cal		*A	*F	*F
Cerastoderma lamarcki lamarki (Reeve)	car				*R
Cerithidium pusillum (Jeffreys)	cep				*R
Cerithiopsis tubercularis (Montagu)	cet			*R	*R
Dreissena sp.	drs		*R	*F	*R
Flexopecten ponticus (Buc., Daut.et Dollf.)	pec				
Gouldia minima (Montagu)	gou				
Hydrobia ventrosa (Montagu)	hyd		*R		*F
Lentidium (Corbula) mediterranea (Costa)	cor				
Loripes lacteus L.	lor				
Lucinella divaricata (L.)	luc				*R
Modiolus adriaticus (Lam.)	moa				
Modiolus phaseolinus (Phillipi)	mod		*D	*A	
Moerella (Tellina) tenuis (Costa)	tel				
Mya arenaria (L.)	mya				
Mysella bidentata (Montagu)	mys				
Mytilus galloprovincialis (Lam.)	myt		*F	*D	*D
Nana (Cyclope) neritea (L.)	cyc				
Ostrea sp.	ost				
Parvicardium exiguum (Gmeln)	cae		*R	*R	*F
Pitar rudis (Poli)	pit			*F	*R
Plagiocardium simile (Milach.)	cas		*F	*A	*F
Polititapes petalina (Lam.)	pol		*R	*R	*R
Rapana thomasiana (Grosse)	rap				
Retusa truncatella (Locard)	ret		*R	*F	*F
Rissoa splendida (Eichwald)	ris		*R	*R	*F
Scala comunis	sca				
Spisula subtruncata (Costa)	spi		*R	*R	
Tricolia pulla (L.)	tri				
Tritia (Nassarius) reticulata (L.)	nas		*A		*R
Trophonopsis breviata (Jeffreys)	tro			*A	*F
Truncatella subcylindrica (L.)	tru		*R	*R	*R
Venus gallina (L.)	veg				

Note: D - dominant
A - abundant
F - frequent
R - rare
* - presence

Table 2: Example of the samples description - BS 23 (varia having hard remnants, other living species)

Station BS - 23

Varia having hard remnants

Sp.	Abreviations	Living sp.	Sampling interval (cm) 0-10	10-20	20-30
Ampelisca diadema (Costa)	amp		*R		
Balanus improvisus (Darwin)	bal				
Bryozoa	bry				
Cliona vastifica (Bowerbank)	cli		*R		
Foraminifera	for				
Lithotamnion	lit				
Melinna palmata (Grube)	mel		*R		
Pectinaria koreni (Malmgren)	pec				
Pomatoceros triqueter (L.)	pom		*R	*F	*R
Spirorbis sp.	spi				

Other alive species

Sp.	Abreviations	Living sp.	Sampling interval (cm)		
Amphiura stepanovi (Djakonov)	ast				
Eugyra adriatica (Drasche)	eug				
Molgula euprocta (Drasche)	mog				
Phyllophora nervosa	phy				
Sycon cyliatum (Fabr.)	syc				

Note: D - dominant
A - abondent
F - frequent
R - rare
* - presence

Table 3: Location of sampling stations within the major depositional systems/zones in the NW Black Sea.

Nr.	Major depositional systems/zones	St.No.	Co-ordinates	Water depth (m)
1	***Danube Delta zone***			
1.1	Delta front area	16	45 32.3061 N; 29 46.5704 E	16
		17	45 12.2347 N; 29 50.8251 E	26
		19	45 04.8827 N; 29 46.8883 E	20
		20	44 44.9527 N; 29 34.9325 E	25.6
		21	44 46.285 N; 29 33.659 E	8
1.2	Danube prodelta	18	45 02.3104 N; 30 18.9323 E	46
		22	44 34.9350 N; 29 11.3791 E	27
		23	44 37.3271 N; 29 42.0474 E	50
1.3	Danube deep-sea fan	2	43 17.2151 N; 31 02.3187 E	1526
2.	***Dniepr mouth zone and Odessa Depression***	6	46 25.4590 N; 31 11.2481 E	23
		7	46 33.0351 N; 31 25.1128 E	8
		8	45 48.1299 N; 31 14.6823 E	30.4
3.	***Dniestr mouth zone***	9	45 55.07 N; 30 33.407 E	17
		10	45 48.585 N; 30 27.407 E	25.4
		11	46 02.97 N; 30 29.18 E	11
4.	***Continental shelf***			
4.1	Sediment starving continental shelf	1	45 00.3820 N; 30 49.9184 E	55
		4	44 21.9087 N; 30 00.5366 E	68
		12	45 10.0190 N; 31 02.9996 E	53
		13	45 35.79 N; 31 52.59 E	38
		15	45 19.9545 N; 30 29.9902 E	37
		14	44 52.97 N; 31 52.59 E	63
4.2	Continental shelf under the influence of the southward drift of Danube-borne sediments	24	44 10.9867 N; 28 43.8973 E	25
		25	43 59.9472 N; 29 21.9037 E	55
		29	43 44.819 N; 28 47.848 E	50
		30	43 07.9906 N; 28 02.6476 E	20.8
		31	43 15.95 N; 27 07.78 E	24
		32	43 21.2626 N; 28 33.9702 E	50
		33	43 12.3000 N; 28 28.4000 E	64
4.3	Continental shelf out of influence of the rivers Danube, Dniepr and Dniestr (Crimean coast)	5	44 24.3938 N; 33 41.5688 E	63
5.	***Continental shelf break near the oxic/anoxic interface***	3	44 00.3866 N; 30 29.0922 E	134
		26	43 41.8390 N; 30 03.4967 E	145
		28	43 19.24 N; 29 08.35 E	123
6.	***Deep sea zone***	27	43 20.35 N; 32 09.25 E	1997

Table 4: List of benthos stations.

Nr. of station date	Water depth (m)	Co-ordinates	Observations
1	2	3	4
1/06.08.95	55	45 00.3820 30 49.9184	Hard bottom consisting of light grey mud with a thin layer of finer oxidised sediment (yellow-brownish colour) on top and *Modiolus phaseolinus* shells. The living organisms *Mytilus galloprovincialis* (25-30 specimens of 20-30 mm long), *Modiolus phaseolinus* (20-25 specimens) and *Plagiocardium simile* (rare) appearing in the Box grab reflect that the station was performed in the ecotonal, transition zone, between the two large biocoenoses of the Black Sea: the grey-blackish mud with *Mytilus* shells and the white "phaseolinus muds" with *Modiolus*.
3/09.08.95	134	44 00.3866 30 29.0755	Typical sea bottom for *Modiolus phaseolinus* association: grey-white clayey mud with some violet valves of leading species. On the surface of the bottom - a yellow-orange film of mainly organic oxidised matter. In the sediment at lower levels there are some old shells of fresh water molluscs (*Dreissena*) beside *Modiolus*. No living organisms have been seen without binoculars on board. It seems the station was carried out within the periazoic benthic level (formerly very characteristic for the Black Sea at water depth grater than 150 m). The lack of macrozoobenthic species in the box-corer could be an argument for the rise of upper periazoic boundary in the Black Sea circalittoral.
4/10.08.95	68	44 21.9087 30 00.5366	*Modiolus phaseolinus* shells in a matrix of whit-grey mud, with a superficial yellow-orange layer. At the bottom surface one can observe numerous living organisms: *Molluscs* (*Modiolus*), *Crustaceans* (*Caprella acanthifera*), *Sponges* (*Sycon ciliatum*) etc. The bottom community seems to be in a good state.
5/ 12.08.95	63	44 24.9938 33 41.5688	*Modiolus phaseolinus* as in st.BS-4 at 68 m water depth associated with different other living organisms: *Molluscs* (*Plagiocardium simile*, *Calyptrea chinensis*), *Echinodermata* (*Amphiura stepanovi*), *Ascidiacea* (*Molgula euprocta*, *Eugira adriatica*) etc. At lower levels in the sediment the diversity of molluscs forms in the thanathocoenosis is very high.
6/13.08.95	23	46 25.4510 31 11.2481	Soft black muddy bottom covered by a thin yellow-orange oxidised layer consisting mainly of organic matter. The upper layer consists of sylty-sandy black mud with H_2S smell, and contains *Abra shells* (*A.alba, A.ovata* and *A. nitida*) as dominant species, together with other *Molluscs*, especially small *Gastropods* (*Bittium reticulatum, Hydrobia ventrosa, Retusa truncatella, Rissoa splendida* etc.); This upper layer seems to be formed in the last decades (showing a high sedimentation rate). Living *Polychaets* could be observed in the upper 25-35 cm of the sedimentary column . The bottom seems to be anoxic but not azoic.
7/ 13.08.95	8	46 33.6351 31 25.1128	The upper black silty mud layer 40 cm thick, with H_2S smell, contains living *Polychaets*. In the subjacent sandy and silty black mud layer one can find shells of *Corbula* and rare *Mytilus* and even *Mya*; the presence of *Mya* shows that these sediments could be formed in the '50-th or '60-th, the subsequent sedimentation rate being very high.
8/13.08.95	30.4	45 48.1299 31 14.6823	Very hard bottom consisting of *Mytilus* shells deposits with grey-yellowish slightly muddy matrix. Valves or broken shells of *Mytilus, Ostrea, Pecten*, etc, are covered by calcareous concretions and *Lithotamnion* crusts. This biotope is typical for the red algae *Phyllophora*; only 2-3 small and thin plants fixed to the shells have been recorded in the samples. Excepting *Phyllophora*, among the living organisms there are mostly mussels.
9/14.08.95	17	45 55.07 30 33.17	Hard bottom consisting of muddy coarse sand and mussels (dominant) and other species (*Ostrea, Pecten* etc.) of shells. The core had only 20 cm in length; the top contained numerous specimens of *Mytilus* living in a good state beside other specimens recently dead (having open valves, rotten meat and strong H_2S smell).

1	2	3	4
10/14.08.95	25.4	45 48.585 30 27.407	Hard bottom: mussel shells (whole and crumbled valves) mixed with heterogeneous sediment (medium and coarse sand and mud). Living organisms: many clusters of *Mytilus* laying on the sea bed.
11/14.08.95	11	46 62.97 30 29.18	Soft bottom consisting of mud covered by grey-yellow matter (oxidised), 1-2 cm thick, with small holes made by organisms The core had 50 cm in length consisting of black soapy mud, sandy sediments with *Adacnida* molluscs shells in the lower part and *Mya arenaria* and other psammobiontic species in the more recent upper silty mud layers. No living organisms have been recorded in the described sample.
12/15.08.95	53	45 10.0190 31 02.9996	Hard sandy and muddy bottom having high content of shells: *Modiolus* in the top layer and *Mytilus* in the subjacent one. The shells of *Modiolus* laying on the bottom surface are "rusted", some of them having calcareous/manganese enveloping crust. Associated living *Modiolus* and mussels prove the zone is an ecotonal one.
13/15.08.95	38	45 35.79 30 48.28	Hard bottom consisting of Sandy mud with mussel shells and living *Mytilus*, *Balanus*, *Hydrobia* and *Phyllophora*. Many shells covered by massive calcareous crusts formed usually by *Lithotamnium* and some encrusting *Polychaeta* (*Serpulida*). The sediment has a high porosity.
14/17.08.95	63	44 52.97 31 52.59	Typical bottom for *Modiolus phaseolinus* biocenosis consisting of shells deposits and light grey mud covered by a very thin layer of yellow-grey matter. Living species: *Modiolus phaseolinus*
15/17.08.95	37	45 19.9545 30 29.9902	Hard bottom, characteristic for *Mytilus - Phylophora* biocenosis, consisting of sandy mud with very high content of mussel shells many of them having calcareous crusts made by *Lithotamnium* and other epibiontic organisms. The box corer brought very few material (a layer of about 20 cm) having on the top clusters of mussels and some feeble blade of *Phyllophora* red algae
16/17.08.95	16	45 32.3061 29 46.5704	Typical anoxic black, "greasy" mud having a superficial layer of yellow-brownish matter (oxidised organic matter and very fine sediments). At 30-40 cm bellow the bottom surface one find *Mya arenaria* shells, having both wholly valves, laying on dark black laminated mud (more dense and compact than the above laying sediments. Living *Polychaets* have been recorded proving that the conditions are anoxic but not azoic
17/ 18.08.95	26	45 12.2347 29 50.8251	Black oozy bottom, having specific smell, with a top layer consisting of yellow-orange very sediments ("rusty creamlike") at the surface worm tubes of 2-3 mm height. In the "greasy mud rare shells of *Mya arenaria* and *Cerastoderma edule lamarckii* , as well as tubes of *Melinna palmata* can be found; galleries of other *Polychaeta* can be observed - the galleries have a distinct colour (yellow-brown) being sometime inhabited by worms penetrating 25-30 cm in the sediment which is rich in organic matter but under anoxic conditions.
18 /19.08.95	46	45 02.3104 30 18.9323	Typical biotop for muddy *Mytilus galloprovincialis* biocoenosis. Sediments in various layers are dominated by mussel valves and debris, some of them covered by *Lithotamnium* crusts. On the top living *Mytilus* have been recorded.
19/19.08.95	20	45 04.8827 29 46.8883	Black mud with layers of different black-grey shades, covered by a yellow-orange "creamy" layer, from which come out thin tubes of *Polychaeta* (*Spionidae*), 2-3 mm high and holes ("craters"), 3-4 mm ø belonging to larger *Polychaets* and to *Mya arenaria*; living *Poliychaets* have been seen penetrating in sediment till ca.30 cm deep; *Mya arenaria* , having blackened shells, have been also found in the sediment column at depth of 7 cm and even 15 cm , laying on more compact sediment beds than the superficial layer
20/19.08.95	25.6	44 44.9527 29 34.9325	Alternance of dark and light black-grey/brown layers covered by a very thin layer of oxidised sediments (yellow-orange "creamy"); small holes (craters) of *Polychaeta* can be observed; living *Cardium edule lamarckii* and *Mya arenaria*

1	2	3	4
22/20.08.95	27	44 34.9350 29 11.3791	Nearshore zone with muddy bottom; numerous *Melinna palmata* tubes are depassing the bottom surface by 1-2 cm and continuing in the sediment about 5-10 cm. Living *Molluscs* : *Mytilus galloprovincialis, Cerastoderma edule lamarckii* and one specimen of *Mya arenaria* (40 mm long) have been found. The sediments are layered in an alternance of differently coloured mud and shelly beds. Thanathocoenosis is containing *Abra alba* shells (as a dominant species) and other molluscs, especially small Gastropods (*Bittium reticulatum, Hydrobia ventrosa, Retusa truncatella, Rissoa splendida*, etc.)
23/20.08.95	50	44 37.3271 29 42.0474	Hard sea bottom consisting of grey sandy mud and many broken shells of mussels in assemblages with other species. The superficial layer - very fine, yellow-brown oxidised "creamy" sediments . Living organisms: *Mytilus* and *Polychaeta* worms
24/21.08.95	25	44 10.9867 28 43.8973	Hard bottom consisting of grey mud and mussels shells (many of them broken) covered by a yellow-brown "creamy" oxidised layer 1.5 cm thick; at the surface small *Polychaeta* holes, rather uniform distributes (ca. 5 holes per 100 cm^2; rare living *Mytilus* are present.
25/22.08.95	55	43 59.9472 29 21.9037	Typical "**Modiolus bottom**"; living forms: numerous and uniform distributed *Modiolus phaseolinus* and *Mytilus* (small size) , rare tubes of *Melinna palmata* (*Polychaeta*) and *Molgulida* (*Ascidiacea*) .
26/22.08.95	145	43 41.8390 30 03.4967	Generally soft bottom with "desert" aspect; on the surface of bottom shells of *Modiolus* are dominant; certain number of valves of *Mytilus*, very thin and friable, 2-3 cm in length are present too. The subjacent layers are formed by grey mud with old *Dreissena* shells. A single living specimen of *Pachycerianthus solitarius* (Rapp) (*Coelenterata*) has been observed.
28/24.08.95	122	43 19. 24 29 08. 35	The upper 15 cm thick layer is formed by clayey muds with *Modiolus phaseolinus*. It overlaps the Mytilus unit consisting of organic and subordinately terrigenous sand with a largely predominating *Mytilus* shells, many of them very friable and broken. At the surface of the bottom there is a thin film of organic matter coating all the shells and the superficial sediments. No macrobenthic living organism has been observed. The periazoic benthic level is placed at ca.120 m water depth.
29/24.08.95	43	43 44.819 28 47.848	Sandy-muddy relatively hard bottom, with many mussel shells (many of them broken) and numerous *Melinna palmata* tubes. The bottom surface is densely covered by living organisms, mainly *Mytilus galloprovincialis* (about 45 specimens of 30-40 mm long on the box corer sampling area - ca.900 cm^2 - that means about 490-500 specimens per m^2) and *Melinna* (ca.1,800 specimens per sq.m)
30/25.08.95	21	43 07.9906 28 02.6476	Relatively soft bottom consisting of sandy mud with rare valves and broken shells of Molluscs (*Chione*, *Mytilus* mostly), and also tubes of *Mellina*. In the grey dark sediment, pierced through the worms, there are some "inclusions" (having the forme and size of a greater olive) of brown-yellowish finer sediments (processed probably by *Melinna*); also few "inclusions" are black coloured. Living organisms: *Melinna palmata* (descending down 15-20 cm); on the suface *Chione gallina* (3 specimens in a subsampler, ca. 150-160 specimens per sq.m), *Balanus improvisus*.
31/25.08.95	19.5	43 15. ,95 27 07. 78	Same biotop as in St. 30/21m (which is ca. 10 Nm to south): quartziferous sandy mud with yellow-brownish superficial layer (2 cm thick) and living *Chione gallina*, *Mellina palmata* and *Tritia (Nassarius) reticulata*. In the sediment there are lents or olive-like "inclusions, blackened or brownish (bioturbations of *Melinna*) and *Mya arenaria* shells (large specimens up to 50-60 mm long, recently dead) and *Mytilus shells*.
32/25.08.95	49	43 21.2626 28 33.9702	Relatively soft bottom, with grey-blackish sandy mud sediments and a brownish-grey top layer containing living organisms as: *Melinna, Cardium sp.* and *Abra nitida*. Thr shells are rare in the sediment, excepting the deep layers (ca. 50 cm) which consist mainly of mussel shells.
33/26.08.95	64	43 12.3000 28 28.4000	Relatively soft bottom consisting of grey sandy mud with rare shells of *Spisula, Plagiocardium simile, Mytilus*, etc., and many tubes of *Melinna palmata*. The stratum of sediments has at the top (2 cm) fine particle brownish deposit. Living *Polychaeta* not only at the upper layers of the sediment, but also deep burried at 15 cm level.

Table 5: Macrozoobenthic organisms recorded in the research area during the Leg 2.

Species	Depth interval (m)	Frequency in the research area (%)	Frequency in the zone where occur (%)	Rank of findings
Phyllophora-red algae	30-40	9.4	100.0	3
Mytilus galloprovincialis	10-20	40.6	59.1	1
Melinna palmata	10-70	18.8	23.1	2
Modiolus phaseolinus	50-70	18.8	66.7	2
Plagiocardium simile	50-70	9.4	33.3	3
Molgula ectoprocta	50-70	6.2	22.2	4
Chione gallina	10-30	3.1	16.7	5
Tritia (Nassarius) reticulata	10-20	3.1	25.0	5
Abra nitida	50-60	3.1	20.0	5
Sycon ciliatum	60-70	3.1	25.0	5
Caprella acantifera	60-70	3.1	25.0	5
Calyptrea chinensis	60-70	3.1	25.0	5
Amphiura stepanovi	60-70	3.1	25.0	5
Eugyra adriatica	60-70	3.1	25.0	5
Balanus improvisus	20-40	6.2	18.0	4
Mya arenaria	20-30	9.4	27.3	3
Spionidae-Polychaeta	20-30	6.2	25.0	4
Cerastoderma edule lamarckii	20-30	6.2	25.0	4
Pachycerianthus solitarius	>100	3.1	33.3	5
Molgula euprocta	50-70	6.2	22.2	4
No life	10-20 >100	12.5	57.1	-
Anoxy with polychaeta	0-30	12.5	30.8	-

Table 6: Distribution of *Aurelia aurita*, *Mnemiopsis* and varia small indeterminated jellyfish species in the NW Black Sea plankton, in August 1995.

A. Average data for 20-0 m water column under 1m^{-2}							
St.	Depth (m)	No. of hauls	*Aurelia*	*Mnemiopsis*	Varia	Total	Observations
1	55	1	31	75	0	106	
2	1500	3	<1	64	23	88	
3	134	3	<1	65	37	103	
4	68	5	<1	86	318	405	
5	63	3	2	72	200	274	
6	23	3	26	58	98	182	
8	30.4	3	1	96	81	178	
12	53	3	15	80	65	160	
13	38	3	25	108	139	272	
14	63	3	+	110	415	525	Extra 40-0 m*
15	37	3	23	151	262	436	
17	26	3	15	416	287	718	
18	46	3	5	349	204	558	
20	25.6	3	19	280	183	482	
22	27	3	<2	222	124	348	
23	50	3	6	420	319	745	
24	27	3	<2	152	297	451	
25	55	3	<1	213	165	379	
26	140	3	<3	76	49	128	Extra 100-0 m*
27	1990	3	+	63	5	68	Extra 100-0 m*
28	122	3	1	29	16	46	Extra 100-0 m*
29	47	3	<1	177	217	395	
32	50	3	0	237	248	485	
33	64	3	3	619	683	1305	
B. Average data for 100-0 m water column under 1 m^{-2}							
St.	Depth (m)	No. of hauls	*Aurelia*	*Mnemiopsis*	Varia	Total	Observations
26	140	1	5	145	59	209	
27	1990	3	3	363	26	392	
28	122	1	5	101	50	156	

* - Supplementary station

II. EROS Danube Delta research cruise (leg 1 - July 6-28, 1995; leg 2 - September 29 - October 15, 1995)

The Danube Delta represents the largest and the most natural wetland in Europe, which works as a buffering interface between the Danube River supplies, collected from a large catchment area, and the western Black Sea. The anthropogenic polluting activities developed in this vast hydrographycal basin, the major regulation works on the Danube River, and the damaging interventions on the Danube Delta area itself have disturbed the natural equilibrium, modifying the dispersal and distribution of sedimentary material, altering the natural percolation of the water, diminishing the retentive capacity of this particularly sensitive deltaic system and causing an increase of the environmental degradation not only of the Danube Delta, but even of the Black Sea.

This study is part of the EROS - 2000 Research Project, aimed at geo-ecological surveying of the Danube - Danube Delta - Black Sea system. The main goals of the project are to obtain up-to-date information on contaminant sources and fluxes, to identify patterns and trends in contaminant input to the main ecosystems, and in dispersal and deposition of the sediments and pollutants, as well, in order to outline the areas under stress, and to assess the mechanisms and intensity of heavy metals, radionuclides, nutrients and other polluting compound retention in sediments, and bioconcentration of pollutants in selected organisms.

During the 1995 research cruise, sediment, water and biota sampling was carried out in 62 stations, located within the main lakes, channels and canals of various interdistributary depressions and also within Razim - Sinoie lacustrine complex (Fig.4).Some physico-chemical analyses (including nutrient concentrations) of the water were performed in situ, on board, using the portable HACH DR DRELL 2000 equipment. Metal and pesticide concentrations in water, grain size, mineralogy, chemistry, radionuclide and pesticide contents of the sediments were determined in Bucharest laboratories.

As concerns the physico-chemical parameters, their distribution patterns are controlled usually by natural factors and subordinately by more or less direct anthropogenic causes. Thus, pH, CND (conductivity) and TDS (total dissolved solids) values are normally higher in the Razim - Sinoie lacustrine complex (characterised by increased salinity, as compared with Danube Delta lakes and channels), and abnormally increased in Lake Dranov (included within the fluvial delta plain area). SS (suspended solids) contents are very variable, and the highest values are controlled by the Danube River suspended sediment inputs (Vencova, Dranov and Dunavat canals, Mesteru and Lungu lakes) and by the phytoplankton blooming (Razim, Golovita, Sinoie, Puiu, Dranov lakes), which points out strong eutrophication tendencies.

The nutrient concentrations in water show generally moderate values for NO_2^- and NO_3^- ,not exceeding the allowable contamination levels; more or less higher values were registered in Vencova, Dunarea Veche, Dranov and Dunavăt channels, and Cutetchi, Durnoi, Uzlina and Razim lakes. Instead, the PO_4^{3-} contents show unexpected high levels for a significant number of the analysed samples.

The metals included on the " Black " list of the Paris Convention (Hg, Cd) show increasing trends in several lakes of Mesteru - Fortuna and Lumina - Rosu depressions and in Dranov, Razim, Golovita and Sinoie lakes, but only Hg exceeds, sometimes, the maximum allowable concentration. As concerns the " Grey " list (As, Cr, Cu, Pb, Ni, Zn),the element concentrations are, generally, within the normal limits for the water, except some samples of Dranov, Golovita and Sinoie lakes. The pesticide (HCH and DDT) concentrations are, also, lower than the allowable limits.

The trace element contents of the sediments are not exceeding, usually, the normal values, but show increasing trends in the areas controlled by Danube River direct supplies (Mesteru - Fortuna, Gorgova - Uzlina depressions and Razim - Sinoe complex),following the Al_2O_3 and Fe_2O_3 evolution. Instead, strong negative correlation's may be observed between trace elements and TOC and CaO contents. Very low pesticide contents in sediments were registered in all studied areas.

As regards sediment radioactivity, natural radionuclides of U-Ra and Th series and K-40 telurik radionuclide have been determined in all samples. The distribution patterns of artificial radionuclides (Cs-137, Cs-134) show increasing tendencies within the Mesteru - Fortuna depression, directly influenced by Danube River supplies, suggesting a hydrological control of the initially uniform Chernobyl radioactive deposits. The assessment of radioactivity was carried out by a team from the Institute of Environmental Research and Engineering.

The chemical data show only moderate to small degradation of the Danube Delta ecosystem, and taking into account earlier information regarding

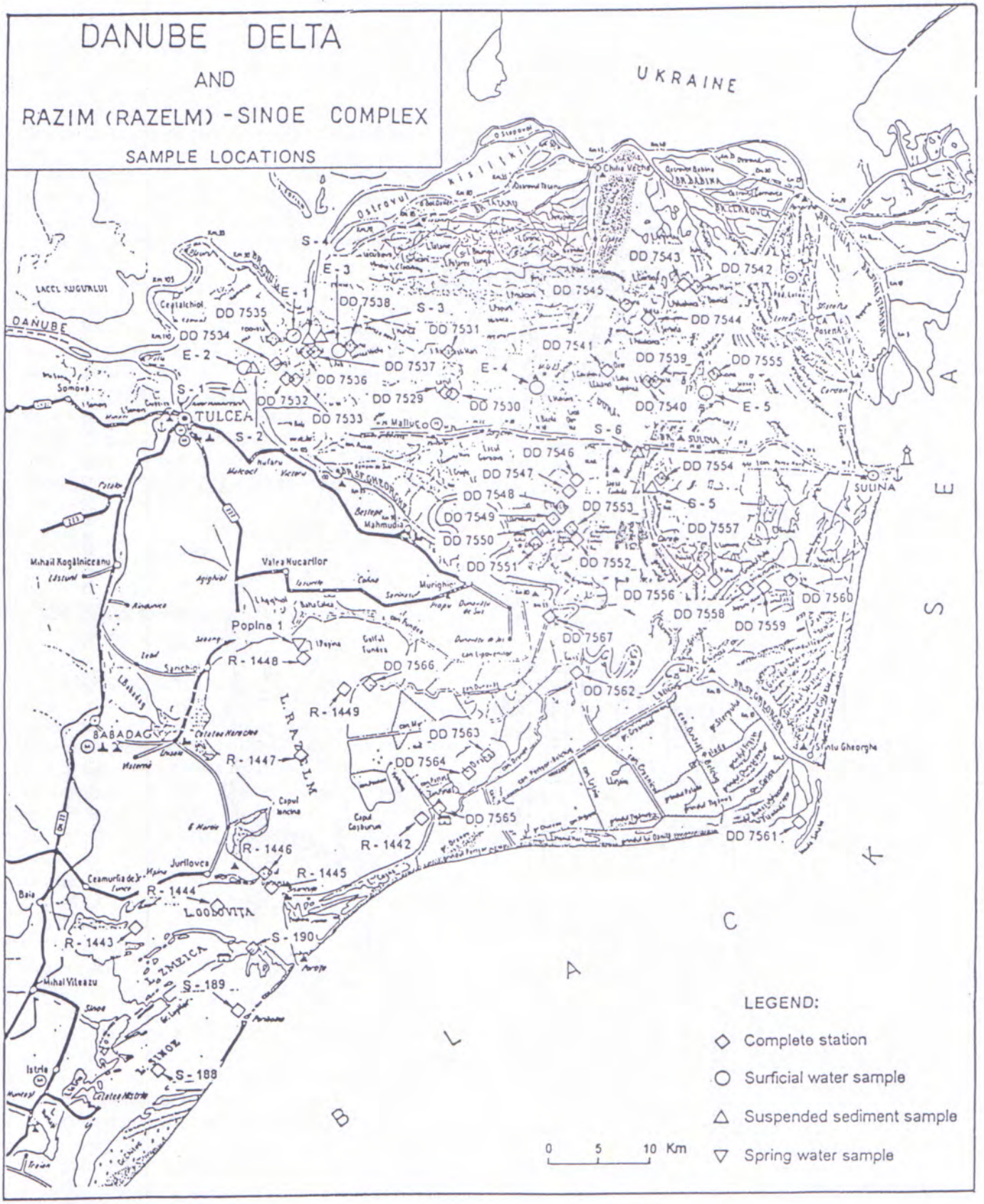


Fig.4 - Map of research area and sample location.

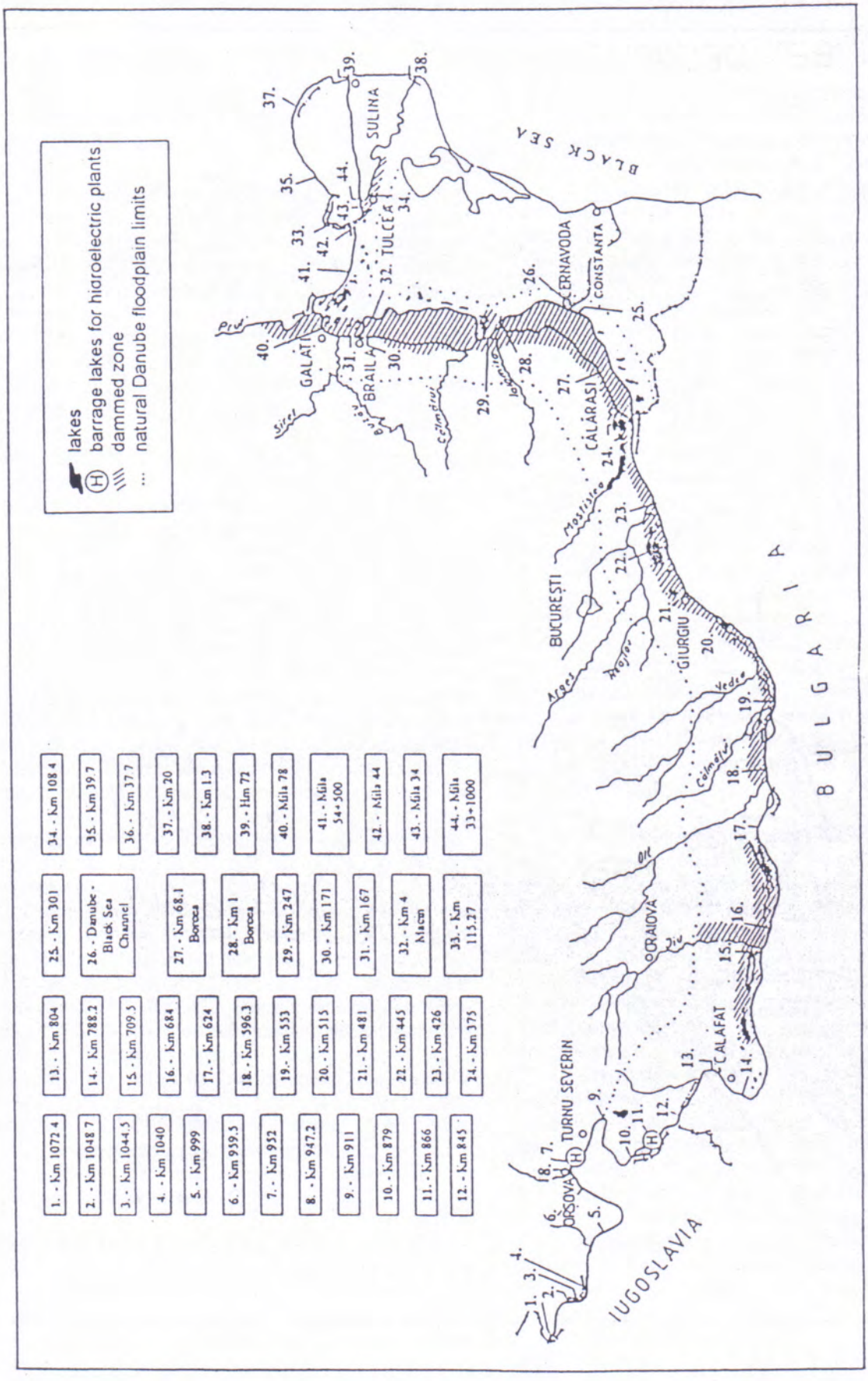


Fig. 5. EROS 2000 Project: Location of the profiles allong the Romanian section of the Danube River

this subject, a chronical pollution of the delta cannot be proved. Some anomalous or generally higher values of contaminants, constantly registered in several lakes included within Mesteru - Fortuna Depression and in Dranov, Golovita and Sinoie lakes, point out the potential status of areas under stress of these zones. The negative impact of the canal Mila 35 is quite obvious. A special attention must be paid to the Lake Dranov, where the water chemistry shows alarming tendencies.

Main sources of pollution and human impacts on the Danube Delta ecosystems are industrial activities, navigation, agricultural chemicals, human waste; these are generally greater around the delta than it is within it. The Danube River water and sediment supplies control the dispersal of the pollutants within the Danube Delta area. The sources of contaminants are generally diffuse, but potential point sources located on land, within the polder areas (old fertiliser deposits) or around Lake Razim - Sinoie complex (pig rearing units, mining activities) may be taken into consideration.

III. EROS River Danube research cruise (June 1 - 29, 1995)

The Romanian sector of the River Danube is over 1,075 Km long. It enter the Romanian territory at Bazias and reaches the Black Sea through tree main distributaries of the delta: Chilia at the North, Sulina in the central part of the delta and Sf.Gheorghe in the Southern part. This lower course drains partially the territory of Yugoslavian Federation, Bulgaria, Romania, Moldova and Ukraine. The course is dammed twice: at Iron Gates I (near by Drobeta - Turnu Severin town) and at Ostrovul Mare (Iron Gates II, at almost 200 Km downstream).

The main goal of the EROS - 2000 - Danube Project is to evaluate the eutrophication and contamination state of the river. Specific objectives include:

- assessment of the bottom morphology by sub-bottom profiling;
- water and sediment fluxes along the river;
- distribution of the bottom sediments;
- determination and distribution of the nutrients, heavy metals and radionuclides in the water and bottom sediments;
- determination of specific constitution of the phyto-plankton, zoo-plankton and macrozoo-benthos along the river;
- trace elements in shells and fishes.

Profiles and core locations

In order to fulfil the objectives of Project EROS - 2000 along the Romanian sector of the Danube, 42 profiles have been sampled (Fig. 5). The profiles were located to evidence the following aspects:

- the degree of contamination of the Danube waters at their entry on the Romanian territory (km 1072,4 - Bazias);
- distribution of the sediments and pollutants within the barrage lakes Iron Gates I and II (profiles from km 1048,7 to km 866), from the Iron Gates II dam (km 864) to the beginning of the Delta (mile 44), as well as along its distributaries Chilia, Sulina and Sf.Gheorghe prior to the entrance in the Black Sea.

Sampling profiles were located at the confluences of Romanian tributaries with the Danube, in order to establish their influence on the Danube. The investigated tributaries are: Cerna, Topolnita, Jiu, Olt, Vedea, Arges, Ialomita, Siret and Prut.

Water and sediment samples have been taken from the Danube - Black Sea channel (Cernavoda area), for identifying organic, inorganic and radioactive pollutants before the beginning of the activity at the nuclear power plant of Cernavoda plant. Sediment cores have been sampled at km 969,5 - Plavisevita, km 959,5 - Ieselnita, km 947,2 - upstream Iron Gates I barrage, km 866 - upstream Iron Gates II barrage, km 72,8 - Sulina arm and km 1,3 - Sf.Gheorghe arm (ex. core D 7700 - Ieselnita).

Water and bottom sediment samples have been taken from each profile for the following analyses:

for water samples (51 samples):

- physical analyses (pH, Eh, O_2 contents, conductibility);
- nutrients (NH_4^+, NO_2^-, NO_3^-, PO_4^{3-});
- organic compounds (detergents, phenols, organic Cl);
- heavy metal (Cu, Pb, Zn, Co, Ni, Cr, Fe, Mn, Ba, Cd, Sc, As, Hg, V);
- natural and artificial radionuclides (Cs 134, Cs 137, K40 etc.);
- phyto - and zooplankton.

for sediment samples (47 samples):

- grain size;
- clay and heavy mineral composition;
- oxides and heavy metals contents;
- natural and artificial radionuclides;
- macrozoobenthos.

Preliminary conclusions

The carried out observation measurements and analyses resulted in the following conclusions:

1. Water and sediment fluxes within the River Danube:

- water discharges were higher during the cruise (June 1 - 30, 1995), compared to the multiannual mean values;
- water level was higher than the multiannual mean level without overpassing the lateral levees.

2. Bottom sediment types and their distribution:

- in the Lake Iron Gates I - silts, muds and medium grain sands;
- in the Lake Iron Gates II - gravels, medium grain sands and silts;
- between Iron Gates II barrage and the beginning of the Danube Delta (Mile 44) -sands and gravels;
- at the mouths of the Danube Delta distributaries (Chilia, Sulina, Sf.Gheorghe) -silts and fine grained sands;

3. Nutrients and heavy metals in the Danube water:

- phenols, phosphates and pesticides are present. Significant exceeding were observed in the Iron Gates I barrage lake;
- Se and Hg concentrations exceed Romanian and EU standards along the entire Romanian sector of the river ; Fe, As, Se and Hg concentrations are higher on the Chilia and Sf.Gheorghe distributaries; according to pH, Eh and rH diagram correlations, the Danube waters are included in the "septic water" category;
- for all the main Romanian tributaries, Se and Hg exceed the standards; Fe an Zn show higher concentrations in Arges and Siret Rivers, As in Jiu, Ialomita and Siret Rivers. The rivers Jiu and Arges are the most polluted with nutrients and heavy metals. The pH, Eh and rH correlations indicate that the river water falls in the following categories: Arges - "anaerobic water" : Olt- "raw water": Jiu, Siret and Prut - "sewer water" : Cerna, Topolnita, Vedea and Ialomita - "septic water".

4. Heavy metal contents in bottom sediments and cores:

- maximal values for most elements (Ca, Ni, Cr, Zn etc.) were observed in the Lake Iron Gates I and in the Moldova Veche area (km 1044 - 1040) and at the beginning of the Danube Delta (Mile 44 - Ceatal Izmail). Abnormal concentrations are due to the fine-grained sediments (silts, muds) adsorbing different pollutants. The anomalous high content at Moldova Veche and Mile 44 could be explained by the impact of the mining and industrial activities within these areas;
- the tributaries Cerna, Jiu, Arges and Ialomita have the highest contents in Cu, Pb, Zn, Cd, Ni, Cr etc., because they are draining areas with intense anthropic activities (industry, agriculture, mining, sewage waters);
- the sediment cores consist mainly of fine sediments (silts, muds, fine sands); there is a clear affinity between the fine sediments and the heavy metal contents: some very fine grained layers are enriched in pollutants: D 7699 at 220 - 260 cm depth - Pb, Zn, Cd, Ni, FE, Co; D 7700 at 70 - 100 cm depth - Ni, Cr, Pb, V, Mn; D 7707 at 156 - 196 cm depth - Pb, Ni, Co, Mn.

5. Radioactivity of the surface waters and the bottom and core sediments (the assessment was carried out by a team of scientists from the Institute of Environmental Research and Engineering).

- higher levels of artificial radionuclides were identified in areas of sediment accumulation (ex. : barrage lake Iron Gates I);
- Chernobyl nuclear accident represents the major source of artificial radioactivity;
- Romanian tributaries show high levels of artificial radioactivity (Cerna - K 40 - 780 ± 13 Bq / kg dry, Siret - 754 ± 9 Bq / kg dry, Olt - 737 ± 13 Bq / kg dry) because their basins have been highly contaminated with Chernobyl fallout due to rainfall in May 1986;
- in the water and the bottom sediments, the levels of artificial radioactivity are lower in 995 than in 1986.

Radioactivity measurements of the core sediments (centimetric sampling) revealed the atomic experiences produced in the atmosphere or important accidents (Chernobyl, 1986). Based on them, sedimentation rates in the selected areas were calculated (ex. barrage lakes). For Barrage Lake Iron Gates I, distinct sedimentation rates occur in different areas :

- Ieselnita area - 1.6 cm/y (core D7700, km 959,5);
- upstream the Barrage Iron Gates I - 2.5 cm/y (core D 7707 - km 947,2).

Appendix 1: List of participants.

Country	Investigator	Address	Research area
Germany	Stephan Reschke scientist	University of Hamburg Institute of Biogeochemistry and Marine Chemistry Grabenstrasse 27 D-20357 Hamburg Tel: 49.40.3497.4269 Fax: 49.40.3497.4259	Biogeochemistry. Determination of sediments and suspended solids composition. Evaluation of seasonal variations of particle fluxes. Determination of origin and degradation processes of particulate organic matter.
	Peter Jöhrendt technician		Box-corer operator. Sediment trap system operator.
The Netherlands	Jeroen Wijsman biologist	Netherlands Institute of Ecology Center for Estuarine and Marine Ecology Vierstraat 28 4401 EA Yerseke Tel: 31.1131.1920 Fax: 31.1131.3616	Modelling of early diagenetic processes, benthic mineralization, population dynamics, fisheries biology.
	Sabine Gerbersdorf biologist		Investigations on Seagrass: epifauna, epiphytes, grazing, nutrient uptake by Zostera.
Romania	Nicolae Panin Prof. Dr. Director Chief Scientist of the leg 2	Romanian Centre of Marine Geology and Geoecology 25 Dimitrie Onciu Street 70318 Bucharest Tel/Fax: 40.1.250.25.94	Marine geology and sedimentology: Danube Delta and Black Sea geological structure and evolution; study of processes of dynamics and sedimentation of particles in fluvial, deltaic and marine environments.
	Silviu Rãdan Dr., senior scientist		Clay mineralogy, sedimentology of the Danube Delta and the Black Sea.
	Marian Gomoiu Prof. Dr., Corresponding Member of the Romanian Academy Deputy Director	Romanian Center of Marine Geology and Geoecology Constanta branch 304 Bd. Mamaia 8700 Constanta Tel./Fax: 40.41.690.366	Marine biology and ecology; assessment of marine life state and resources evaluation in the Black Sea.
	Dan Secrieru Dr., senior scientist, head of geochemistry laboratory		Marine geochemistry; assessment of pollution of sediments with heavy metals.
	Irina Popescu scientist, geologist		Sedimentology of continental shelf, slope and Danube deep-sea fan.
	George Enescu		Satelite navigation, seismoacoustics and marine acoustics.

Country	Investigator	Address	Research area
Russia	Mikhail V. Ivanov Prof. Dr., Academician, Director	Institute of Microbiology, Academy of Sciences Prosp. 60-letija Octjabrja 7 117811 Moskow B-312 Tel: 7.095.135.21.39 Fax: 7.095.135.65.30	
	Alla Y. Lein Prof. Dr. Head of laboratory of geochemistry and sedimentary rocks	Institute of Geochemistry and Analytical Chemistry Kosygin St. 19 117975 Moskow V-334 Fax: 7.095.938.20.54	
	Nikolay V. Pimenov Dr., scientist		
	Igor I. Rusanov scientist		
Spain	Jordi Dachs scientist	Department of Environmental Chemistry Centre of Research and Development, CSIC Jordi Girona 18-24 E-08034 Barcelona, Catalunya	Marine chemistry, study of sources, occurence and fate of organic pollutants and biomarkers (PAH, PCB, Sterols, ...) in the water column of the marine environment.
	Cristina Maldonado scientist		Marine chemistry, study of occurence and diagenetic processes of organic pollutants in marine sediments. Partition of organic compouns between particulate and dissolved phase in the water column.
Switzerland	Gabriela Friedl scientist	Swiss Federal Institute for Environmental Science and Technology EAWAG LImnological Research Center CH-6047 Kastanienbaum Tel: 41.41.48.21.21 Fax: 41.41.48.21.68	Study of early diagenesis in sediments of eutrophic lakes: measurements of diffusive fluxes across the sediment water interface; identification of authigenic solid phases; the role of the solid phases in the retention capacity of sediments for nutrients.
	Christian Dinkel technician		Operator of the benthic flux chamber.
Ukraine	Viktor Egorov Dr., Co-chief scientist Head of Department of Radiation and Chemical Biology	Institute of Biology of Southern Seas (IBSS) 2 Prospekt Nakhimova 335011 Sevastopol Telex: 197301 BIOS UX	Radiochemoecology; mechanisms of interaction between living matter and both radioactive and chemical pollutants in the marine environment using radiotracers and mathematical modelling; Black Sea methane gas seeps, flow of CH_4 bubble streams to the hydro- and atmosphere.
	Sergey Gulin Dr., Head of Laboratory of Dynamic Chemical Ecology		Radiochemoecology; Dynamic environmental toxicology; Pollutans transfer to the sediments and the chronology of their deposition.

Country	Investigator	Address	Research area
Ukraine	Igor Polikarpov Dr., Head of Laboratory of Microplankton	Institute of Biology of Southern Seas (IBSS) 2 Prospekt Nakhimova 335011 Sevastopol Telex: 197301 BIOS UX	Biology of marine microplankton; microbial loop and their dynamics in the sea; long-term changes in the marine micro- and phytoplankton communities.
	Maxim Gulin Dr., Head of Laboratory of Chemoecology and Environment Forming Gases		Chemoecology; Black Sea seeps (ecological microupwelling effect of CH_4 gas bubble streams in the meromictic water system); Black Sea ecological redox structure (bacterial chemosynthesis; O2/H2S mixing layer and pH/Eh prophiles; $Mn^{+4}/O_2/NO_3$ oxidizing role).
	Nikolai Stokozov scientist		Physical oceanology; Studies of shelf and vertical water mixing using long-lived radionuclides 90Sr and $^{134, 137}Cs$ as a tracers.
	Yuri Artyomov scientist		Acoustics; Study of characteristics of the acoustic responce of (a) organisms, (b) sediments, (c) gas bubble streamsin the Black Sea on the basis of acoustics and computing; modelling of underwater backscattering processes; database management.
	Vladimir Popovichev scientist		Radiochemoecology; phosphorus metabolism (^{32}P), pollutants.
	Sergey Schurov scientist		Oceanography; Study of hydrophysical processes; Mathematical and on location modelling of diffusion processes in the sea.

Appendix 2: List of participants in the EROS - Danube Delta cruise (leg 1 - July 6-28, 1995; leg 2 - September 29 - October 15, 1995)

Country	Investigator	Address	Research area
Romania	Silviu Rădan Dr., senior scientist	Romanian Centre of Marine Geology and Geoecology 25 Dimitrie Onciu Street 70318 Bucharest Tel/Fax: 40.1.250.25.94	Clay mineralogy, sedimentology of the Danube Delta and the Black Sea
	Claudia Strechie scientist		Geochemistry of water and sediments in the Danube Delta
	Dumitru Grosu chemist		
	Irina Popescu scientist, geologist	Romanian Centre of Marine Geology and Geoecology Constanta branch 304 Bd.Mamaia 8700 Constanta Tel/Fax: 40.41.690.366	Sedimentology of continental shelf, slope and Danube deeo-sea fan
	Gyongyi Ruzsa scientist	Institute of Environmental Research and Engineering Environmental Radioactivity Laboratory 294, Splaiul Independentei 77703 Bucharest	Radiochemoecology. Water and sediment activity in the Danube River and Danube Delta
	Gheorghe Brezeanu Dr., senior scientist	Biological Institute of Academy 296, Splaiul Independentei 77703 Bucharest	
	Victor Zinevici Dr., senior scientist		
	Dorina Nicolescu Dr., senior scientist		
	Doina Ionică, Dr., senior scientist		
	Laura Teodorescu senior scientist		
	Gabriel Oltean scientist		
	Mihai Serban technician		
	Aurel Terente technician		
USA	Kate Lajtha Ph.D. Associate Professor	Oregon State University - Department of Botany and Plant Pathology Cordley Hall 2082, Corvalis, Oregon 97331-2902	Biochemistry. Ecosystems ecology

Appendix 3: List of participants in the EROS - Danube Delta cruise (June 1-29, 1995)

Country	Investigator	Address	Research area
Romania	Oaie Gheorghe Dr., senior scientist Head of Laboratory of Marine Geology and Sedimentology	Romanian Centre of Marine Geology and Geoecology 25 Dimitrie Onciu Street 70318 Bucharest Tel/Fax: 40.1.250.25.94	Sedimentology of marine and fluvial deposits, study of the dynamics and evolution of sediment structures, correlation between pollutants and sedimentary environment
	Szobotka Stefan scientist		Geochemistry; heavy metal concentration in fluvial and lacustrine sediments
	Rãdan Silviu Dr., senior scientist		Clay mineralogy; sedimentology of the Danube Delta and Black Sea
	Gomoiu Marian Prof.Dr., Member of the Romanian Academy Deputy Director	Romanian Centre of Marine Geology and Geoecology Constanta branch 304 Bd.Mamaia 8700 Constanta Tel/Fax: 40.41.690.366	Marine biology and ecology; assesment of fluvial life state and evolution in River Danube
	Secrieru Dan Dr., senior scientist Head of Laboratory of Geochemistry		Marine geochemistry; assesment of sediment pollution with heavy metals
	Bondar Constantin Dr., senior scientist Head of Laboratory of Hydrology	Institute of Meteorology and Hydrology 97, Sos.Bucuresti-Ploiesti Bucharest, Romania	Interpretations of the bathymetric measurements, water and solid discharges in fluvial, deltaic and litoral environments
	Gyongyi Ruzsa scientist	Institute of Environmental Research and Engineering Environmental Radioactivity Laboratory 294, Splaiul Independentei 77703 Bucharest	Radioactivity; artificial and natural radionuclide concentrations in water and sediments as well as the chronology of their deposition
	Bacalbasa Nicolae Prof.Dr.		
Germany	Reschke Stephan scientist		Biochemistry; composition of sediments and suspended solid and degradation processes of particulate organic matter