fifty years

"FLOATING UNIVERSITY" FACILITY

INNOVATIVE TRAINING THROUGH RESEARCH

Summary of activities of the
UNESCO-MSU Research and Training Center and Chair
for Marine Geology and Geophysics

UNESCO

Annual Report, 1995

The "Floating University" Project's 5th "Training-through-Research" cruise (1995) has been included on the List of Events for the celebration of the 50th Anniversary of the United Nations.
In 1995, the United Nations Educational, Scientific and Cultural Organization (UNESCO) also celebrated its 50th Anniversary.
This report, issued as a contribution to the above event, summarizes the activities of the UNESCO-MSU Research and Training Center for Marine Geology and Geophysics.

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Front cover: Geological excursion during the 1995 post-cruise meeting, United Kingdom (Photo: J. Woodside)

Back cover: Mud volcanic field in the Kerch Peninsula (Photo: E. Kozlova)

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UNESCO-MSU RESEARCH AND TRAINING CENTER FOR MARINE GEOLOGY AND GEOPHYSICS AND THE TTR PROGRAMME

(SUMMARY)

The scientific and educational programmes of the UNESCO-MSU Research and Training Center for Marine Geology and Geophysics, affiliated with the Faculty of Geology, Moscow State University (MSU), are aimed at advanced Training-through-Research (TTR) for undergraduate and postgraduate students, based on international cooperation programmes with the involvement of universities and research institutions of many countries (Annex 1).

The TTR Programme was designed in 1990 by an international group of scientists under the auspices of UNESCO and, later, the European Science Foundation (ESF) to benefit from the advantages provided by the combination of the training of students and young scientists and "cutting-edge" research in the geomarine field. A long-term plan for annual TTR cruises was developed for the Mediterranean and Black Seas. The main objective of the Programme is to generate and share advanced knowledge through: (i) state-of-the art training and education in a specific geomarine field, and (ii) acquisition of high-quality data during the TTR cruises for the furthering of various scientific targets. The Programme is managed by the Executive Committee (Coordinator: Dr. J. Woodside, Free University of Amsterdam, the Netherlands) and supported by UNESCO (through its "Floating University" Project), ESF (through its Scientific Networks Committee) and various national funding sources. The Intergovernmental Oceanographic Commission of UNESCO also decided (June 1995) to co-sponsor the "Floating University" Project.

The annual cycle of the TTR Programme includes the following steps: (i) preparation of a TTR cruise by the Executive Committee, including the selection of the cruise foci; (ii) the cruise itself, with a mid-cruise training workshop for the participating students (with an exception in 1995, caused by changes in the original programme); (iii) preliminary data processing, preparation of the cruise scientific report and its publication by UNESCO; (iv) post-cruise meeting of the student-participants and senior research staff to present and discuss the results of ongoing analysis and interpretation of data obtained during the TTR cruises; and (v) preparation of scientific publications.

Between 1991-95, five major TTR cruises, four mid-cruise workshops and three post-cruise meetings were organized under the Programme, in addition to a number of other field exercises, group and individual training activities, discussion and publication of the research results.

The Center operates under the following arrangements. MSU provides the staff of the Center (currently 5 persons). Fifteen students of the Geology Faculty (of which six are post-graduate students) are involved in the various research programmes. In 1995, funds for research and training activities were provided by MSU, the Russian Ministry for Science and Technological Policy, the Russian Committee for Geology, as well as by UNESCO, ESF, France, the Netherlands and the UK.

The Center has two branches: **Marine Geology and Sedimentology**, and **Geophysics and Geo-acoustics**. It provides various laboratories for research needs as well as computer services, including the central Sun workstation for geophysical data processing. The Center is supported by a series of central services provided by MSU, through the Administration of the Geology Faculty: libraries, Science Park, central e-mail service, analytical laboratories, etc. It enjoys close collaboration with many Departments of the Geology Faculty ensuring the necessary marine-related training for the students. It also cooperates with various institutions of the Russian Academy of Sciences such as the Geological Institute, the Institute of Lithosphere, the Shirshov Institute of Oceanology, as well as with the Yuzhmorgeo Co. and the Polar Expedition of the Russian Committee for Geology. In 1995, cooperation was initiated with the National Academy of Sciences of the Ukraine.

Moscow State University

1995 RESEARCH AND TRAINING ACTIVITIES OF THE CENTER

1. Research projects

A number of research projects mostly of regional character continued to be executed at the Center by the MSU research staff and students, in particular:

In the Black Sea:

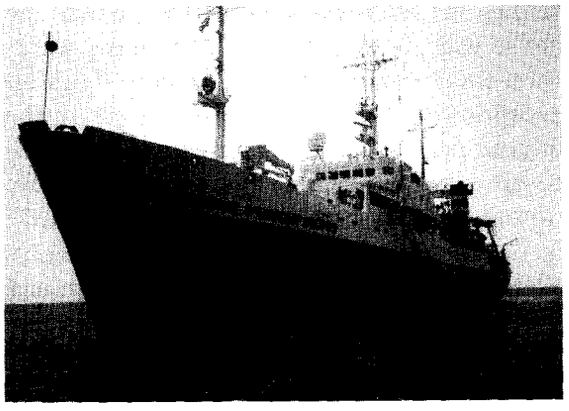
- Geophysical evidence of hydrocarbon potential in the Black Sea basin;
- Lithology, geochemistry and origin of the Black Sea mud volcanism;
- Mud volcanism of the Kerch peninsula (Crimea): a comparison with the Black Sea deep-water mud volcanism;
- Comparative characteristics of the Black and Mediterranean Seas mud volcanism and mechanisms of their emplacement;
- Seismic and acoustic data giving evidence of gas charge in upper sedimentary cover in the Black Sea deep water mud volcano area;
- Seafloor morphology in the Black Sea mud volcano area from observations with the MAK deep-tow acoustic system and regional sea-floor sediment sliding in the central part of the Black Sea;
- Mineralogical analyses in turbidites from the central part of the Black Sea;
- Features and origin of the Danube deep-sea fan;

In the Mediterranean region:

- Neotectonics of the Mediterranean Sea and its evolution during the Neogene-Quaternary;
- Deep-sea depositional systems;
- Mechanisms of the Mediterranean mud volcanism and diapirism;
- The seafloor morphology of the United Nations mud volcano area (E. Mediterranean);
- Discrimination of mud flows of the Mediterranean Ridge mud volcanoes on the basis of deep-towed sidescan sonar data analysis;
- Mud volcanoes and brine pools on the Mediterranean Ridge south of Crete;
- Lithology and geochemistry of mud breccia matrix and rock clasts from the Mediterranean Ridge mud volcanoes and their sources;
- Geological interpretation of sidescan sonar data from the area of the Stromboli volcano;
- Silty and sandy layers in the Holocene-Upper Pleistocene sediments in the Marsili Basin (Tyrrhenian Sea) and their possible sources;
- Application of seismic data analysis for the reconstruction of the evolution of the Tyrrhenian Sea;
- Multibeam echosounder data interpretation for the Anaximander Mountains area;
- Eratosthenes Seamount: collisional processes in the Easternmost Mediterranean in relation to the Plio-Quaternary uplift of S. Cyprus;
- Improving geological interpretation of seismic data from the Eratosthenes Seamount area by their processing;
- Biostratigraphy of the Late Quaternary sediments of the Eastern Mediterranean;
- Late Quaternary deep-sea benthic foraminifera from the Corsico-Sardinia Region and their relation to palaeo-oceanographic changes;
- Grain-size and mineralogical analyses of sediments in the distal part of the Ajaccio Canyon (Algero-Provencal Basin);
- Late Quaternary sedimentation patterns in the North Aegean Sea;

Projects of general nature and studies in non-Mediterranean regions:

- Comparative characteristics of deep-sea fans of the world;
- Development of methods of marine geological-geophysical investigations;
- Development of methods of digital processing of seismic and acoustic data;
- Study of migration and accumulation processes of hydrocarbons;
- Genetic study of sedimentary rocks;
- Processing and geological interpretation of the Towed Ocean Bottom Instrument (TOBI) data for the northeastern and southwestern Faeroe continental margin (the Norwegian Sea);
- Evolution of the sedimentary basins on the NW Pacific continental margin;
- Study of seismic facies and character of the bottom simulating reflector on the western margin of Paramushir Is., Sea of Okhotsk.



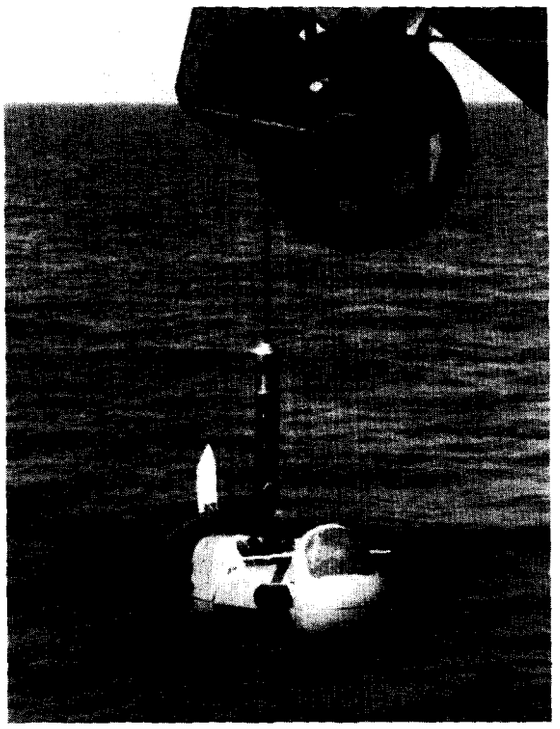
R/V Prof. Logachev (photo: W. Ordelman)

2. Field work and expeditions

2.1. The 5th "Floating University" cruise

The fifth TTR cruise was organized onboard the R/V *Prof. Logachev* (sister ship of the R/V *Gelendzhik* used for the first four TTR cruises), which belongs to the Polar Expedition of the Russian Committee for Geology. The cruise was co-sponsored by UNESCO, ESF, the Russian Committee for Geology, the Russian Ministry for Science and Technological Policy, the Netherlands Organization for Scientific Research (NWO) and the University of Milan. The Netherlands Institute for Sea Research (NIOZ) provided support which permitted the ship to visit Texel on the way to the Mediterranean, and IFREMER (France) provided support which permitted a visit to Brest (France) on the way back to St. Petersburg (Russia). Other relevant expenses (such as travel of the cruise participants) were covered from national sources and/or UNESCO. The cruise co-chief scientists were: M. Ivanov (MSU), J.P. Foucher (IFREMER) and A. Limonov (MSU).

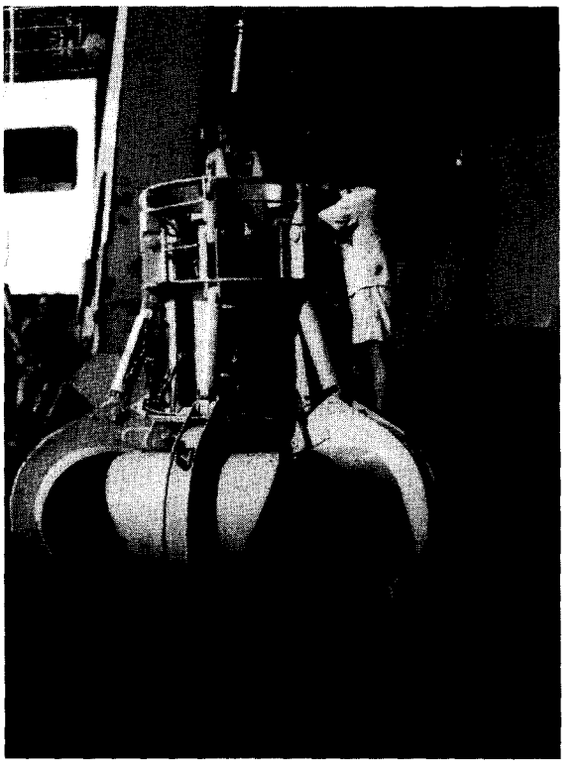
The equipment used aboard the R/V *Prof. Logachev*, provided mostly by the Polar Expedition, but also by the Shirshov Institute of Oceanology, included: a 10 kHz onboard profiler, 6-channel seismic with 2.1- and 1.5-litre airguns; a long-range sidescan OKEAN and a deep-towed sidescan ORETECH with a 5.5 kHz subbottom profiler, a 3-beam echosounder, various types of bottom samplers (such as a 147 mm gravity corer, a box corer and a TV-controlled bottom grab sampler), geochemical equipment for analysis of hydrocarbon and some other gases, as well as some other devices. A GPS navigation and underwater navigation system Sigma 1001 ensured the positioning of the ship and deeptow instruments. Eleven personal computers were at the disposal of research staff and students for shipboard data processing.



Deep-towed sidescan ORETECH (photo: W. Ordelman)

Students at work with a gravity corer, under the supervision of M. Ivanov (left) (photo: W. Ordelman)

The expedition started from St. Petersburg on 29 July with the Russian team aboard, and terminated at the same place on 25 September. For the international leg the R/V *Prof. Logachev* sailed from Ierapetra, Crete, on 18 August with 47 scientists and students from Bulgaria, France, Italy, the Netherlands, Russia, Switzerland, Turkey, and the UK (see Annex 2). She returned to Heraklion, Crete, on 2 September after 14 days of intensive work at sea. The main target of the expedition was an area located 200 km south of Crete on the crest of the Mediterranean Ridge. It was anticipated that this area could be a zone of active mud volcanism and fluid expulsion. Only a few hours after it had left Ierapetra, the scientific team knew that it would not be disappointed when the first run of the OKEAN long-range sidescan sonar recorded several large dark spots that indicated possible mud volcanoes.



TV-controlled bottom grab sampler (photo: E. Kozlova)

The exploration then focused on the south-eastern part of the submarine rise, where promising dark spots had been detected. This appeared to be a rather big area of mud volcanism and gas venting which differs greatly from what was known before on the Mediterranean Ridge. Geophysicists deployed the ORETECH high resolution sidescan sonar – towed 100 m above the seafloor, sedimentogists took about 30 sediment cores, and geochemists sampled the recovered cores for systematic organic geochemistry analysis. Three mud volcanoes were mapped in detail within the above rise, and two were successfully cored. (They were named "Stoke-on-Trent" and "Dublin" following the tradition established by the Italian scientists, who first studied the Mediterranean mud volcanoes in detail, to name these features after the hometowns of principal researchers involved in their discovery). In the survey area, a huge volume of mud was interpreted as having erupted over the past 100,000 years; some of the flows were judged to be as recent as within the last 2,000 years.

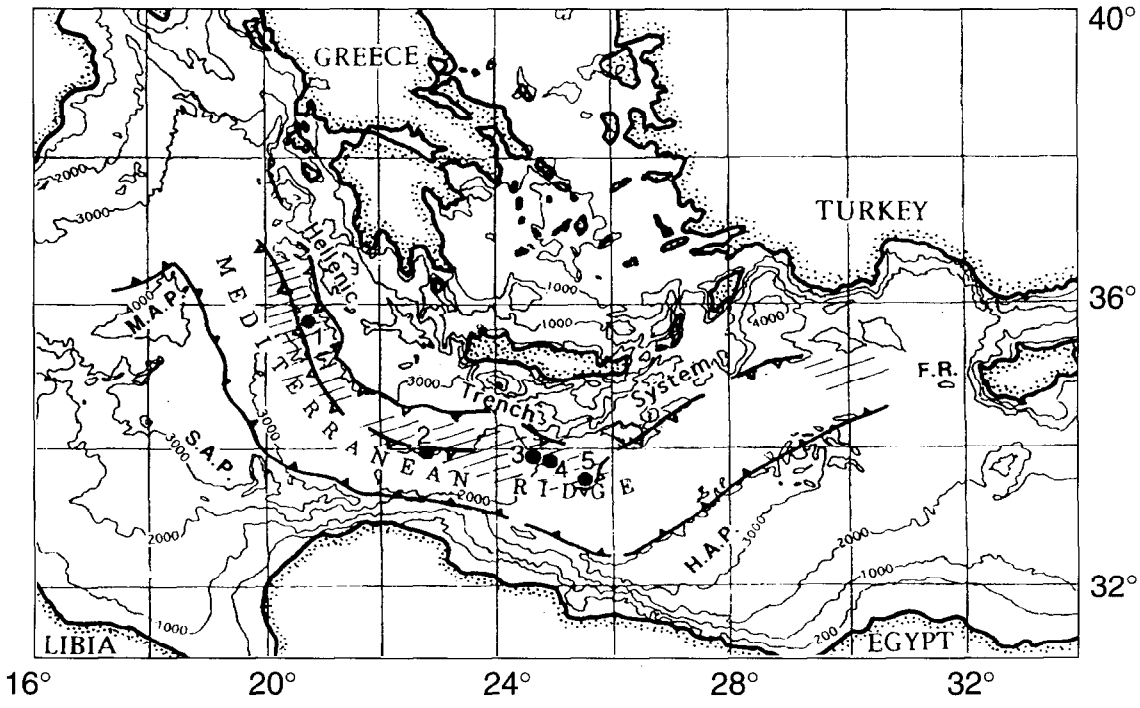
A TV-controlled grab sampler brought up from the crater of the Stoke-on-Trent mud volcano a sample of mud breccia (about 1.5 ton), which contained two large blocks (over 70 kg each) of sandstones and conglomerates, deposited probably well over 50 millions years ago (Paleogene-Mesozoic?). It is believed that these blocks were extruded by large mud flows from a depth of a few kilometres below the seafloor. A TV profile was recorded across the crater.

Among other results of the cruise are large fields of bowl-shaped depressions a few metres to 200-300 metres across, seen on high resolution images of the seafloor. These depressions, known as pockmarks, are thought to indicate active sediment degassing or fluid escape through the seafloor, controlled by faults. Sediments loaded in methane and various heavier hydrocarbon gases were sampled both on the rise and in the basin to the northeast of it. Also catching the attention of the research team was the discovery of several brine pools that were revealed from the inspection of the seafloor images obtained with sidescan sonars. The largest discovered one, named "Logachev", is over two kilometres long.

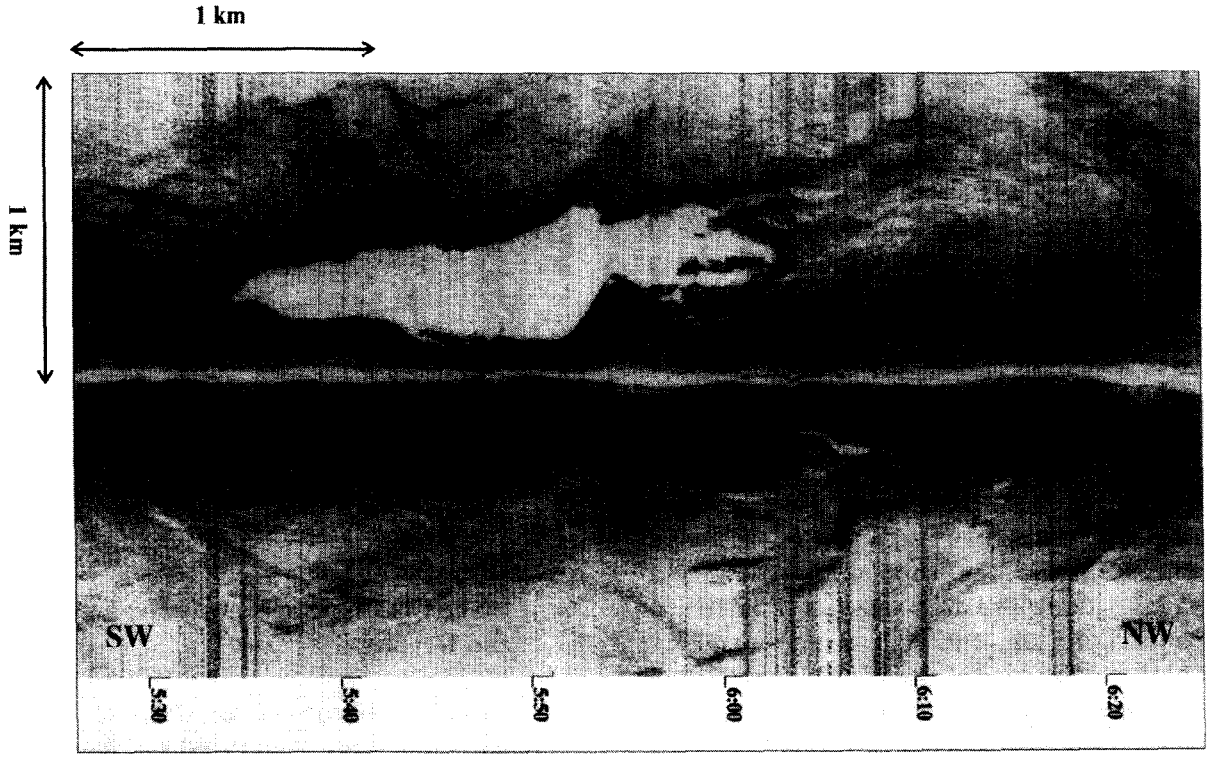
During the cruise, lectures and seminars were given to students by the research staff of the expedition and several students (Annex 5).

Following the discovery during the 3rd and 4th TTR cruises of several mud volcano fields on the western and central Mediterranean Ridge, the 5th TTR cruise was very successful in demonstrating that the mud volcano belt extends to the eastern Mediterranean Ridge. To commemorate the 50th anniversary of the United Nations, it was proposed to call the newly discovered and investigated bathymetric high "The United Nations Rise".

'Trophy' from the deep: B. Cronin and W. Ordelman examining a block of ancient rocks taken by a grab sampler (photo: E. Kozlova)



Schematic map showing the general position of the Mediterranean Ridge and mud volcano areas in the Eastern Mediterranean. The Mediterranean Ridge mud volcano belt is hatched. 1. Cobblestone-3 area; 2. Pan di Zucchero area; 3. Prometheus 2 area; 4. Olimpi area; 5. The United Nations Rise. Lines with solid and open triangles indicate the Outer and Inner deformation fronts of the Ridge respectively. M.A.P. – Messina Abyssal Plain; S.A.P. – Syrte Abyssal Plain; H.A.P. – Herodotus Abyssal Plain; F.R. – Florence Rise. Compiled by M.K. Ivanov, J.P. Foucher and A.F. Limonov.



The ORETECH deep-towed sidescan image of the Logachev *brine pool discovered East of the United Nations Rise*

Far from being an inert frontier, the deep seafloor of the Eastern Mediterranean Sea produces mud volcanoes, numerous fluid seepages and brine pools. The large volumes of the fluids and gases, escaping from the sediments, influence the chemistry of the sea-water above it. Scientists and students of the 5th TTR expedition are convinced that geological and geochemical processes on the deep seafloor need detailed investigation to assess the role of these processes in the changing Mediterranean marine environment.

One of the recent mud volcanoes, Kerch peninsula (photo: E. Kozlova)

Following an invitation from NIOZ, the R/V *Prof. Logachev* stopped at Texel (4 August) on her way to the Mediterranean, thus permitting the shipboard team to visit this leading marine institution of the Netherlands. Following an invitation from IFREMER, the R/V *Prof. Logachev* visited Brest (15-16 September) on the way back to Russia. A visit to the IFREMER laboratories, as well as a meeting with French scientists to discuss the expedition's results were organized by the host institution. This also permitted the shipboard scientific party and students to get acquainted with research programmes of this leading French marine institution.

2.2. Linking marine-land geology: field studies on the geology of mud volcanoes of the Kerch peninsula

With a view to comparing deep-sea mud volcanoes with the ones on land, field studies at the Kerch peninsula (Eastern Crimea, Black Sea) were organized by the Center between 12-30 June 1995, in cooperation with the Ukrainian State Institute of Mineral Resources. The Kerch peninsula's tectonic pattern is characterized by the development of long, narrow synclines separated by wide anticlines with mud volcanoes situated on their crestal parts.

Three major types of mud volcanoes known in the region were the focus of the expedition. Located in the southwestern part of the Kerch peninsula, the Jau-Tepe mud volcano is amongst the biggest in size (its diameter is more than 1.5 km, with a height of about 60 m), it has a regular conical shape with multiple mud flow descending from the crater to hundreds of metres away. The activity of this type of mud volcano is of an explosive catastrophic character. Short periods of activity are followed by long dormant stages. The Bulganak and Tarhan volcanic fields (located in the northeastern part of the peninsula) are currently active. In contrast with the Jau-Tepe mud volcano, these volcanic fields are wide, nearly round depressions and do not have any main crater. Multiple griffons, developed there minutely, spit out small amounts of gassy mud. The Jarjava mud volcano, located in the eastern part of the peninsula, is a hill of about 15 m high and 300 m in diameter. It represents a transitional type of volcanic activity. For the first time ever, the distribution of mud flows for all the above-mentioned mud volcanoes was mapped in detail, to study the peculiarities of mud volcano morphology and compare deep-sea mud volcanoes with those on land. Ancient and recent mud flows, mud breccia with fragments of underlying rocks, and associated gases were sampled.

The Bulganak volcanic field (photo: E. Kozlova)

3. UNESCO Chair in Marine Geology and Geophysics

As per the agreement between UNESCO and MSU signed in 1994, the UNESCO Chair continued to function as part of the UNESCO-MSU Center. The general objectives of the Chair, as described in the 1994 Annual Report,

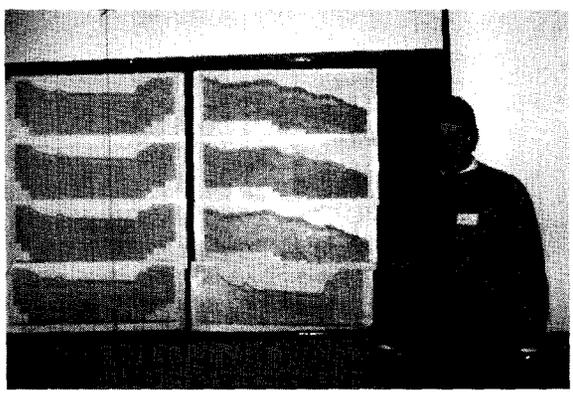
are related to further development of twinning and other types of bilateral and multilateral inter-university cooperation and promotion of educational programmes in marine geosciences, as recommended by UNESCO's *"Year 2000 Challenges in Marine Science Education Worldwide"* plan (1986) and in particular as a follow up of the recommendations of the UNESCO Workshop on *"The University Field Courses in Marine Sciences"* (1989).

Examples of Chair activities in 1995:

(a) The selection of MSU students for TTR cruises remains one of the major activities of the Chair. The Faculty of Geology (MSU) has fourteen departments with some 1300 undergraduate and postgraduate students. TTR cruises are open to all interested in marine geosciences, but as the number of places onboard is limited, only those most qualified may participate. Upon presentation of candidates by the departments, the Chair sets up informal exams. In 1995, the first series of exams took place in January, followed by another round in April. The final list of the MSU participants, agreed upon with the various departments, was prepared mid-May.

(b) The Chair regularly organizes seminars in marine geosciences for students. Students report on their research (Annex 3). Among international visiting professors who gave seminars and lectures during the 1994-95 and first semester of the 1995-96 academic years were Prof. J. van Hinte, Dr. J. Woodside (Free University of Amsterdam, the Netherlands), Dr. A. Robertson (University of Edinburgh, UK), Prof. E. Bonatti (Institute of Marine Sciences, Bologna, Italy).

(c) Following a contest for students, organized in November-December 1994, a group of 10



One of the students' presentations: Mr. I. Korotkov (photo: J. Woodside)

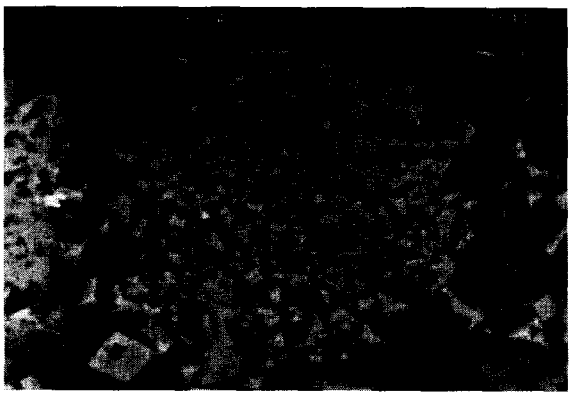
A group of MSU students in London (photo: E. Kozlova)

MSU students participated in the 3rd post-cruise meeting (30 January - 3 February 1995, Cardiff, UK) and presented their research results based on TTR cruises (see Annex 4).

(d) Another contest for students aimed at discussing their research presentations was organized in November-December 1995 in preparation for the 4th post-cruise meeting, scheduled for January-February 1996. Students to attend the above international meeting were selected.

(e) The programme of the Chair also includes short- and mid-term study grants for students enabling them to participate, as described below, in the activities of leading European laboratories on data processing and analysis and to obtain the supervision necessary for undergraduate and postgraduate projects.

(i) An MSU post-graduate student, Mr. G. Akhmanov, was granted a fellowship (28 January - 24 March) to process data obtained during the 3rd (1993) and 4th (1994) TTR cruises from an area of development of mud diapirism on the Mediterranean Ridge. Under the supervision of Dr. S. Wakefield (University of Wales, College of Cardiff, UK) the lithology and geochemistry of mud breccia matrix and clasts recovered from the newly discovered mud volcanoes were studied with a view to identifying the source of the material. A grain-size analysis of the fine fraction of the mud breccia matrix, X-ray studies of the clay mineral composition of the mud breccia matrix and clasts, and the microscopic study of clasts in thin sections were carried out. Under the guidance of researchers and staff of the Cardiff Marine Geosciences Research Group and for the first time ever, an XRF analysis of trace- and major-element geochemistry of the

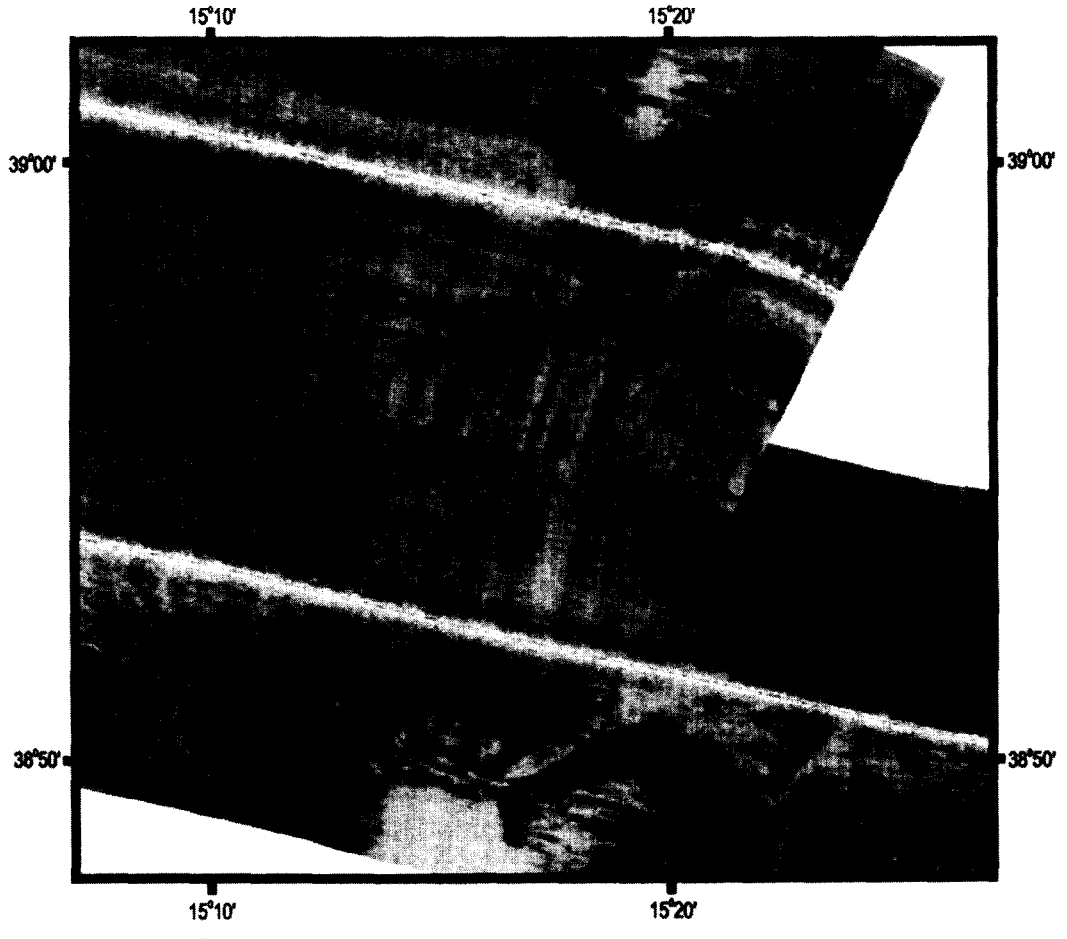


Scanning electron microscope view of a siderite framboid in the limestone fragment from the breccia of the Cobblestone-3 Area, Mediterranean Ridge (TTR-4 cruise, 1994) (photo made at the University of Wales, UK)

Mediterranean mud breccia was carried out. Besides, the micro-composition and texture of some samples of clasts from mud breccia were identified using a scanning electron microscope and a wavelength dispersive X-ray spectrometer. A genesis of source rocks for mud breccia was defined. These rocks were deposited at least 6.5 million years ago, buried subsequently and are now situated at a depth of a few kilometres below the sea floor. Their fragments (breccia) were transported to the sea bottom due to mud volcano activities. The resulting mud breccia from the central part of the Mediterranean Ridge was formed in a deep-water environment at some distance from the continental slope, while the genetic features of the material from the western part of the ridge indicate shallow-water conditions of its deposition.

The results of these studies were presented at the 16th IAS Regional European Meeting of Sedimentology (24-26 April, Aix-les-Bains, France). Discussions on the results with scientists of the University of Wales led to conclusions on ways to further investigate the Mediterranean mud breccia lithology. During his stay at the University of Wales, G. Akhmanov also finalized a manuscript dedicated to the lithology of mud volcano breccia from a mud diapiric area studied during the 3rd TTR cruise, which was submitted to *Marine Geology* (see Annex 4). The above study visit was supported by MSU and the University of Wales.

(ii) Under the MSU-NWO arrangements, an MSU postgraduate student, Mr. A. Volgin, was



Digital mosaic of OKEAN side-scan sonar, Stromboli canyon, TTR-4 cruise (1994) (A. Volgin, J. Woodside, 1995; see Annex 4)

granted a fellowship (28 January - 31 March) to develop, under the supervision of Dr. J. Woodside (Free University of Amsterdam, the Netherlands), the original software for processing sidescan sonar data, as well as to process and make a geological interpretation of the above data obtained during the 4th TTR cruise (1994) from the area near the Stromboli volcano (Tyrrhenian Sea). As a final step, the software includes mapping and mosaicking of sidescan sonar data, and their combining with bathymetric data and any additional information. This technique was used later during the 5th TTR cruise (1995). Under the same grant, Mr. Volgin attended the 3rd post-cruise meeting (Cardiff, UK), as well as the 34th CIESM Congress (Valetta, Malta), where he made a presentation, in co-authorship with Dr. J. Woodside, on the research results (see Annex 4).

(iii) In February-April, Mr. E. Basov, an MSU postgraduate student, visited NIOZ (The Netherlands) where he processed and analyzed, under the supervision of Dr. Tj. van Weering, seismic data obtained in 1994 during the Sea of Okhotsk expedition, which was organized through the INTAS 93-1881 project of the EC. The studied area is characterized by a giant vent of gas from the sea bottom. Maps of the uppermost seismic facies distribution and a structural map of the investigated area on the western margin of Paramushir Island were compiled. It has been concluded that temperature is the most important factor controlling the gas hydrates' stability and that it is the locally higher heat flow which causes the upward migration of the hydrate stability field and the subsequent degradation of hydrated sediments and the a.o. methane flux to the water column and atmosphere. This study visit resulted in the preparation of an article (in co-authorship with C. Gaedike, Tj. van Weering and B. Baranov - see Annex 4). The study grant was provided through the above EC project.

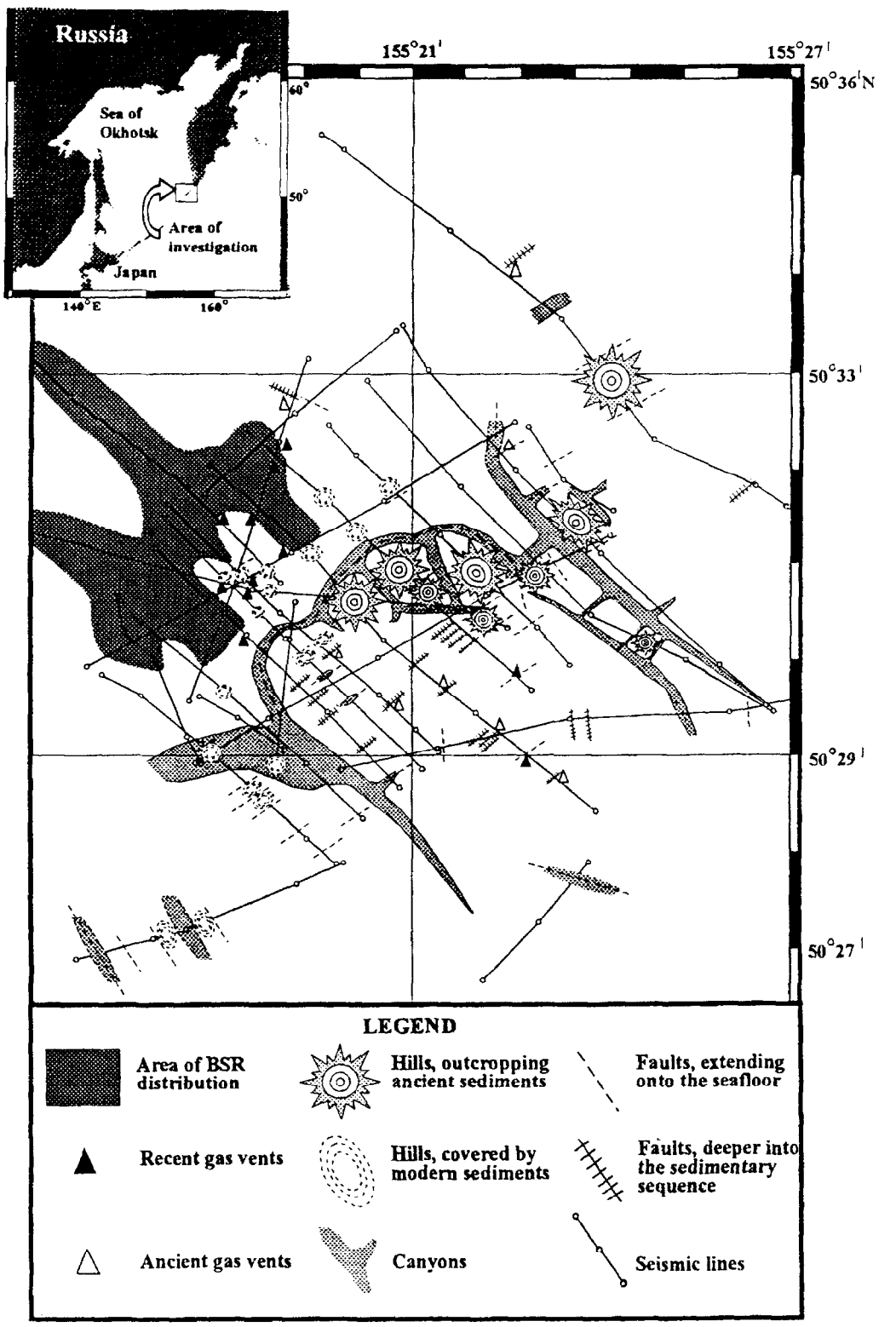
(iv) Following an invitation from Dr. J. Woodside, the Coordinator of the three-year Dutch "Anaxiprobe" project to study in detail the Anaximander Mountains area in the Eastern Mediterranean (its origin, geological evolution and neotectonics), two MSU postgraduate students, Mr. S. Bouriak and Mr. R. Almendinguer, participated between 4-16 August in the "Anaxiprobe 1995" cruise onboard the R/V *l'Atalante* (France). They became acquainted with the multibeam echosounder system technique and contributed to the expedition's report in the corresponding section; they also participated in discussions on a preliminary interpretation of the data obtained so far by the project. It is planned (if accepted by the Dutch counterparts) that one or both of the above MSU students will continue working on the "Anaxiprobe" data under the supervision of the project's Coordinator and will possibly take part in further "Anaxiprobe" expeditions (1996 and 1997). Participation of the two MSU students in the project, in 1995, was supported by GOA and MSU.

In 1991 the Anaximander Mountains were investigated during the 1st TTR cruise onboard the R/V *Gelendzhik* when bottom sampling, seismic, gravity, magnetic and sidescan sonar surveys were carried out. The data obtained during that cruise were among the sources on which the formulation of the "Anaxiprobe" project was based.

(v) Following an invitation from Dr. Tj. van Weering (NIOZ), Ms. E. Akenticva, an MSU postgraduate student, participated in the Dutch expedition (19 June - 13 July) onboard the R/V *Pelagia* (The Netherlands) to the northeastern and southeastern Faeroe continental margin (the Norwegian Sea). Ms. Akentieva was trained in using the Towed Ocean Bottom Instrument (TOBI) system for detailed imaging of the sea floor. Between 14 July - 15 August she took part in TOBI data processing at NIOZ, including the construction of a sidescan sonar mosaic and geological interpretation of the survey results. Later she continued TOBI data processing at the Southampton Oceanography Centre, UK (2 November - 2 December) and the Free University of Amsterdam, The Netherlands (3-20 December). Study grants were provided by NIOZ with financial participation from MSU.

(vi) As a follow up to the participation of IFREMER in the 5th TTR cruise, an invitation came from this institution for Mr. R. Almendinguer, an MSU postgraduate student, to process sidescan data under the supervision of the cruise co-chief scientist, Dr. J.P. Foucher (2 November - 15 December, Brest, France). A grant was provided as part of the agreement between MSU and the University of Paris-VI.

(vii) Two MSU postgraduate students, Ms. E. Ivanova and Ms. A. Lototskaya, who were provided in 1994 by NWO (the Netherlands) with long-term fellowships leading to Ph.D diplomas, continued their research at the Free University of Amsterdam.



Morphological and structural map of the investigated area in the Sea of Okhotsk (BSR – bottom simulating reflector) (from: E. Basov et al., submitted)

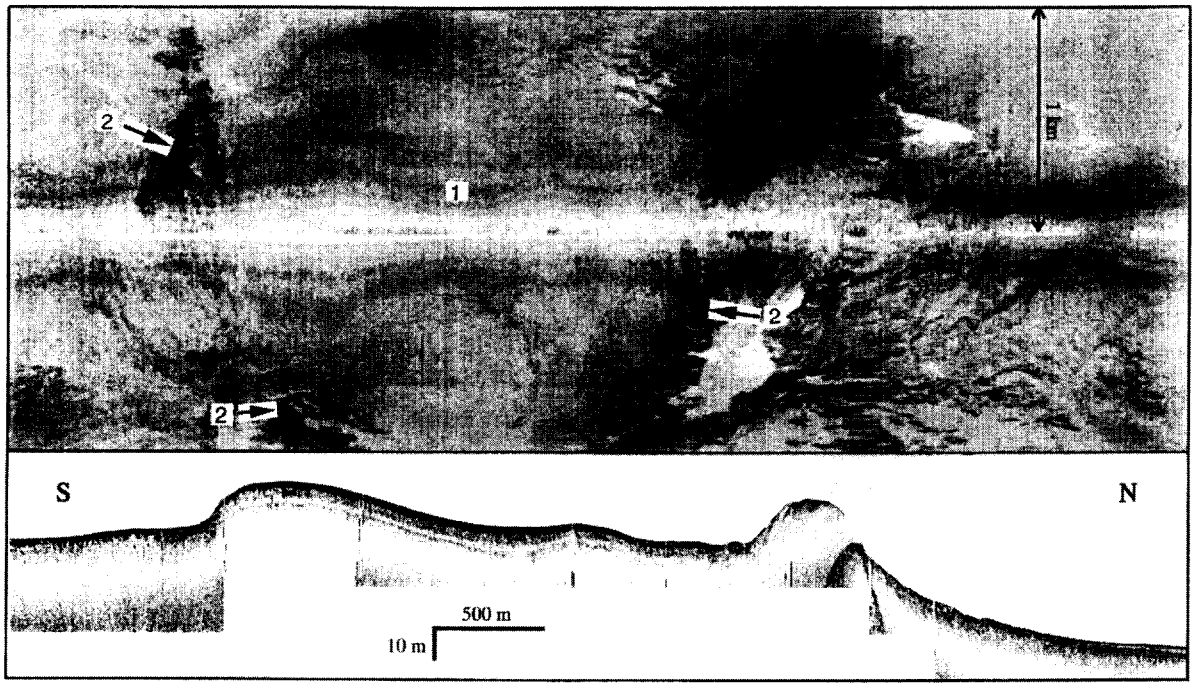
4. Research visits: a tool for cooperation

The geological interpretation of data obtained during the 1st to 4th TTR cruises was the major subject of the research visit of Dr. M. Ivanov to The Netherlands (February-April). In NIOZ, in cooperation with Dr. Tj. van Weering, processing and interpretation of the Black Sea geophysical data (1991 and 1993 cruises) were carried out. Negotiations with NIOZ on the participation of an MSU student in the research cruise of the R/V *Pelagia* resulted in a grant to Ms. Akentieva (see 3(e)(v) above). Dr. Ivanov continued his research visit at the Free University of Amsterdam, where, in cooperation with Dr. J. Woodside, data of the 4th TTR cruise were processed and analyzed. A few seminars were given to students of the above university, in particular on the geology of the Crimean peninsula, in preparation for their field training in summer 1995 at the MSU Field Station in Central Crimea. Several proposed bilateral and multilateral projects were discussed with the Free University, NIOZ and GOA staff, including the organization of the 5th TTR cruise, the participation of MSU students in the "Anaxiprobe 1995" cruise (see 3(e)(iv) above), etc. As co-editor of a special issue of *Marine Geology* and in cooperation with two other co-editors (Prof. M.B. Cita and Dr. J. Woodside), Dr. Ivanov revised manuscripts submitted by the participants of the 3rd TTR cruise (see Annex 4), attended the meeting of scientific editors of the special issue, and discussed the matter with the Elsevier Publishing Company. A grant was provided by GOA with financial participation from MSU.

5. Meetings and workshops

5.1. UNESCO-ESF planning and coordination meeting and Third post-cruise meeting (26 January - 3 February, Cardiff, UK)

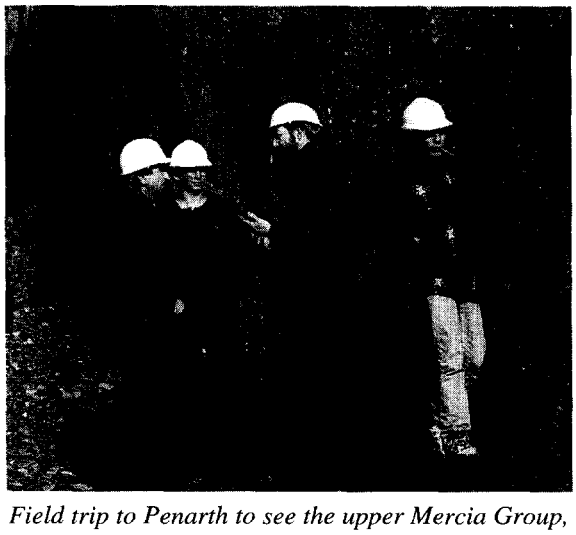
The 3rd post-cruise meeting, organized and hosted by the Department of Earth Sciences, Cardiff University of Wales (UK), was attended by 45 scientists and (mostly) students who took part in various TTR cruises. The main objectives were to present and discuss the results of ongoing analysis and interpretation of data obtained during the cruises (Annex 5). Among the participants, 10 undergraduate and postgraduate students, as well as 4 researchers came from MSU. A volume of abstracts was published by UNESCO as *MARINF/99* (see Annex 4). Travel grants for MSU participants were provided by UNESCO, ESF, UK, The Netherlands and Russia.



A buried mud volcano in the Cobblestone-3 Area, TTR-4 cruise (1994). 1. Buried caldera; 2. Volcanic rim (from: Ivanov, M.K., Limonov, A.F. and van Weering, Tj.C.E., 1995; see Annex 4)

Dr. J. Woodside (left) with Russian students during the Cardiff meeting (photo: E. Kozlova)

A three-day UNESCO-ESF planning and co-ordination meeting preceded the one above. The programme of the 5th TTR cruise (1995) was discussed in detail, the research objectives were determined and specific targets selected. A proposal for submission to the EC MAST Programme on "Mechanisms of Mediterranean Mud Volcanism" (M3V) was finalized.



Field trip to Penarth to see the upper Mercia Group, Rhaetic and Lower Liassic formations. From left: M. Ivanov, J. Clark and N. Kenyon (photo: E. Kozlova)

5.2. 34th CIESM Congress (27 March - 1 April, Valetta, Malta)

The CIESM Congress was attended by Dr. A. Limonov, Mr. A. Volgin and Ms. A. Lototskaya, who presented some results of the TTR programme (see Annex 3). This time, the usual TREDMAR round table took place under the guidance of Mr. A. Limonov. During the round table, plans for the TTR-5 cruise and methods of investigation were discussed in detail. Two travel grants out of three were provided by UNESCO and one jointly by the Netherlands and MSU.

5.3. 8th Meeting of the European Union of Geosciences (9-13 April, Strasbourg, France)

The meeting was attended by Dr. O. Krylov, who presented a poster on rifting and sedimentary basins in the Okhotsk and Bering Seas. Abstracts of two other papers (submitted by Ms. Akentieva and Mr. Bouriak) were also accepted and published (see Annex 4).

5.4. The Annual M.V. Lomonosov Research Conference at MSU (19-27 April, Moscow)

M. Ivanov and A. Limonov presented a keynote lecture on "Mud volcanism and diapirism of the Black and Mediterranean Seas" at the Annual M.V. Lomonosov Conference, which was attended by over one thousand participants from Russia mostly.

5.5. 16th IAS Regional European Meeting of Sedimentology (24-26 April, Aix-les-Bains, France)

The regional meeting of the International Association of Sedimentologists (IAS) was attended by two MSU students, Mr. G. Akhmanov and Mr. A. Akhmetjanov, who presented papers on the lithological composition of the mud breccia from the Mediterranean Ridge mud volcanoes and on silty and sandy layers from bottom sediments in the Marsili Basin (Tyrrhenian Sea). Travel grants were provided by MSU.

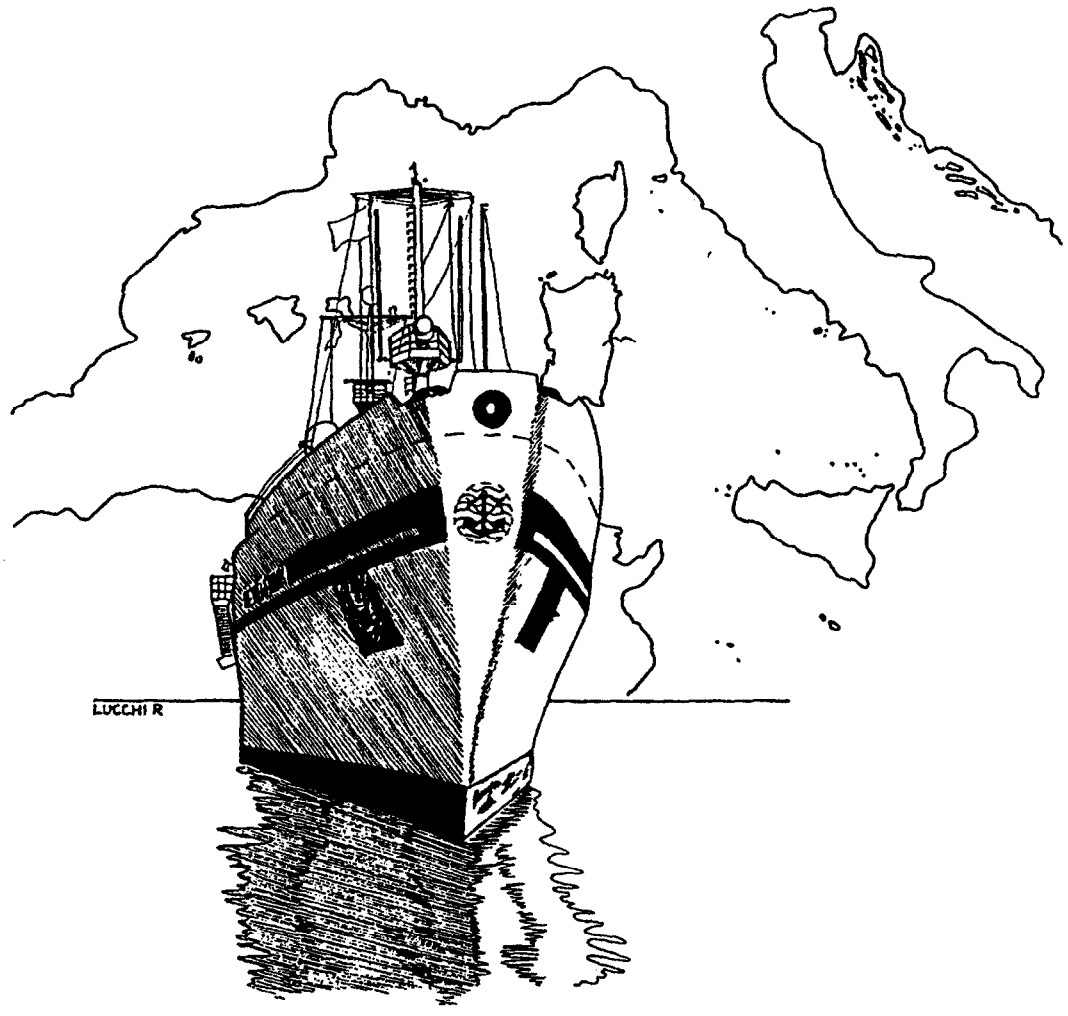
5.6. International Earth Science Colloquium on the Aegean Region (9-13 October, Izmir-Gulluk, Turkey)

Six MSU researchers and students attended the above colloquium and made five oral and one poster presentations on the results of the TTR cruises as follows: M.K. Ivanov – The principal results of the 5th Training-through-Research Cruise aboard the R/V *Prof. Logachev*; A.F. Limonov, N.H. Kenyon, M.K. Ivanov, Tj. van Weering, and L.B. Meisner – Regional seafloor sediment sliding in the central part of the Black Sea; E.I. Basov – Main patterns of the Late Quaternary sedimentation in the North Aegean Sea; A.M. Akhmetjanov – Danube deep-sea fan: the main features and origin; V.G. Gainanov – Some results of seismic data processing

from the TTR-5 Cruise to the Eastern Mediterranean; E.V. Kozlova (poster) – The seafloor morphology of the United Nations mud volcano area (Eastern Mediterranean). Dr. M. Ivanov and Dr. A. Limonov were conveners of two sessions on marine geology. Travel grants were provided by UNESCO.

6. Cooperation with the Intergovernmental Oceanographic Commission (IOC) of UNESCO

The Intergovernmental Oceanographic Commission convened on 21-24 March an *ad-hoc* TEMA Strategy Meeting (UNESCO Headquarters, Paris), attended by Dr. M. Ivanov, who introduced the "Floating University" project. The meeting recommended the strengthening of relations with TREDMAR, of which the "Floating University" is a part. As a follow up, the 18th session of the IOC Assembly (June) decided to co-sponsor the "Floating University" project. IOC Resolution XVIII-14 states, *inter alia*: "The Intergovernmental Oceanographic Commission ... decides to co-sponsor through TEMA the "Floating University" project in the Mediterranean, Black and Baltic Seas ... in view of enhancing the continuation of these initiatives; financial implications to the IOC: US$20,000 ...".



Detail of a poster announcing the 3rd post-cruise meeting (Cardiff, 1995) designed by R. Lucchi

Annex 1

LIST OF INSTITUTIONS WHICH COOPERATED WITH THE UNESCO-MSU CENTER IN THE EXECUTION OF THE "TRAINING-THROUGH-RESEARCH" PROGRAMME IN 1995

Bulgaria	Institute of Oceanology, BAN (Varna)
France	IFREMER (Brest) University Pierre and Marie Curie (Paris and Villefranche-sur-Mer)
Italy	University of Genoa (Genoa)
The Netherlands	The Netherlands Organization for Scientific Research (NWO) (The Hague) The Netherlands Geoscience Foundation (GOA) (The Hague) Free University (Amsterdam) The Netherlands Institute for Sea Research (NIOZ) (Texel) University of Utrecht (Utrecht)
Russia	Ministry of Science and Technological Policy (Moscow) Russian Committee for Geology (ROSCOMNEDRA, Moscow) Russian Oceanographic Committee (Moscow) Shirshov Institute of Oceanology, RAN (Moscow) Institute of Lithosphere, RAN (Moscow) Paleontological Institute, RAN (Moscow) Polar Marine Geological Survey Expedition, ROSCOMNEDRA (St. Petersburg) YUZHMORGEO Co., ROSCOMNEDRA (Gelendzhik)
Switzerland	University of Neuchatel (Geological Institute, Group LIMNOCEANE) (Neuchatel)
Turkey	Dokuz-Eylul University (Izmir) Piris Reis Foundation for Maritime & Marine Resources Development (Izmir)
The Ukraine	The Ukrainian State Institute for Mineral Resources (Simferopol)
United Kingdom	University of Wales (Cardiff) University of Southampton (Southampton) Southampton Oceanography Centre
European Science Foundation	Scientific Networks Committee (Strasbourg, France)
UNESCO (Paris, France)	Science Sector (COMAR, PROMAR and TREDMAR Programmes) Education Sector (UNESCO Chairs programme) Intergovernmental Oceanographic Commission (IOC)

5TH "TRAINING-THROUGH-RESEARCH" CRUISE

National legs (30 July - 17 August and 3-24 September) and
International leg (18 August - 2 September):
scientific and technical staff and students

LIST OF PARTICIPANTS

(countries indicated according to the current affiliation of the participants)

Bulgaria

Lyobomir Dimitrov (Institute of Oceanology BAN, Varna)

France

Jean-Paul Foucher (IFREMER, Brest)

Italy

Adriano Mazzini (University of Genova)

The Netherlands

Muhsin Koktas (University of Utrecht)
Eelco Felser (Free University, Amsterdam)
Ewald Iking (Free University, Amsterdam)
Ekaterina Ivanova (Free University, Amsterdam)
Stella Kortekaas (Free University, Amsterdam)
Bianca van Zon (Free University, Amsterdam)
Catherina van der Zel (Free University, Amsterdam)
Wouter Ordelman (Free University, Amsterdam)

Switzerland

Rachel Huber (Institute of Geology, University of Neuchatel)

Turkey

Gunay Cifci (Dokuz Eylul University, Izmir)

UK/EIRE

Bryan Cronin (University of Wales, Cardiff)
Craig Hunt (University of Southamptom)

Russian Federation

Alexey Krotov (Polar marine geological survey expedition - PMGE - St. Petersburg)
Petr Krinitskiy (PMGE)
Vjacheslav Gladysh (PMGE)
Sergey Ljubimov (PMGE)
Viktor Sheremet (PMGE)
Alexander Ivanov (PMGE)
Alexander Marakulin (PMGE)
Gennadiy Antipov (PMGE)
Irina Antipova (PMGE)
Vladislav Desfonteynes (PMGE)
Vladimir Poymanov (PMGE)
Juriy Goremykin (PMGE)
Vladimir Fomenko (Yuzhmorgeo Co., Gelendzhik)
Valery Podshuveit(Yuzhmorgeo Co., Gelendzhik)
Eugeny Shevclev (Yuzhmorgeo Co., Gelendzhik)
Alexey Bjakov (Yuzhmorgeo Co., Gelendzhik)
Michael Ivanov (Moscow State University)
Anatoly Limonov (Moscow State University)
Sergey Burjak (Moscow State University)
Pavel Shashkin (Moscow State University)
Eugeny Karpekin (Moscow State University)
Valery Gaynanov (Moscow State University)
Anna Volkonskaya (Moscow State University)
Olga Ivanova (Moscow State University)
Alina Stadnitskaya (Moscow State University)
Elena Kozlova (Moscow State University)
Grigorii Akhmanov (Moscow State University)
Andrey Akhmetjanov (Moscow State University)
Kirill Svinarenko (Moscow State University)
Tatiana Efimova (Moscow State University)
Irina Belenjkaya (Moscow State University)
Roman Almendinger (Moscow State University)
Leonid Akentiev (Institute of Oceanology RAN, Southern Branch)
Sergey Kraskovskiy (Institute of Oceanology RAN, Southern Branch)
Alexander Egorov (Institute of Oceanology RAN)

LIST OF SEMINARS AT THE UNESCO-MSU CENTER, 1995

1 March	**S. Bouriak** – Summary on the scientific results of the 3rd "Training-through-Research" post-cruise meeting, Cardiff, UK
	Dr. A. Limonov – Programme of the 1995 "Floating University" cruise
15 March	**Prof. Frolov** – Turbidites and flysh deposits
	Prof. Frolov – Underwater weathering (halmyrolysis) and its importance in sedimentation
12 April	**G. Akhmanov** – Composition of mud breccia clasts from the Mediterranean mud volcanoes (Report on a study visit to the University of Wales, Cardiff)
	Dr. A. Limonov – Summary of the scientific presentations at the CIESM Congress, Malta, 1995
28 April	**A. Volgin** – Processing and interpretation of the side-scan sonar data from the Tyrrhenian Sea (Report on a research visit to the Free University, Amsterdam, The Netherlands)
	E. Basov – Mud diapirs and gas hydrates of the Okhotsk Sea (Report on a research visit to NIOZ, Texel, The Netherlands)
5 October	**A. Akhmetjanov** – Danube deep-sea fan: main features and origin
	E. Basov – Main patterns of the Late Quaternary sedimentation in the North Aegean Sea.
	E. Kozlova – The seafloor morphology of the United Nations Rise.
	Dr. V. Gainanov – Some results of seismic data processing from the United Nations mud volcano area
16 November	**Dr. E. Gabrina** – Diatoms and their role in Quaternary sediments stratigraphy
	Dr. A. Limonov – Summary on the scientific results of the International Earth Science Colloquim on the Aegean Sea Region (9-13 October, Turkey)
30 November	**Prof. E. Bonatti** – Geological development of the South Atlantic Ocean

LIST OF PUBLICATIONS DERIVED FROM THE TRAINING-THROUGH-RESEARCH PROGRAMME

Akentieva, E. Morphology of Mud Volcanoes of the Olimpi Area in the Eastern Mediterranean and Some Tectonic Features of the Region (According to Geophysical Data from the 1993 Cruise). Recent Marine Geological Research in the Mediterranean and Black Seas through the UNESCO/TREDMAR Programme and its Floating University Project. Abstracts of the 2nd post-cruise meeting, 31 January - 4 February 1994, Amsterdam. *MARINF/94*, UNESCO, 1994, 13-14.

Akentieva, E.L. The Mediterranean Ridge Mud Diapiric Belt: Sidescan Sonar Survey. EUG-8, 9-13 April, Strasbourg (France). Abstract supplement No.1 to *Terra Nova*, v. 7, 1995, p. 204.

Akentieva, E. Discrimination of Mud Flows of the Mediterranean Ridge Mud Volcanoes on the basis of MAK-1 Sonograph Analysis. Abstracts of the 3rd post-cruise meeting, Cardiff, 30 January - 3 February 1995. *MARINF/99*, UNESCO, 1995, p. 19.

Akhmanov, G. Mud Breccia Clasts from the Mediterranean Sea: the Results of a Study of their Composition. Recent Marine Geological Research in the Mediterranean and Black Seas through the UNESCO/TREDMAR Programme and its Floating University Project. Abstracts of the 2nd post-cruise meeting, 31 January - 4 February 1994, Amsterdam. *MARINF/94*, UNESCO, 1994, p. 14.

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Akhmanov, G. The Mud Volcanism on the Mediterranean Ridge: the Example of the Reconstruction of Ancient Sedimentary Environments on the Basis of the Mud Breccia Lithological Composition. 16th IAS Regional Meeting of Sedimentology, Aix-les-Bains, 24-26 April 1995. Abstracts book, p. 2.

Akhmanov, G. Lithology of Mud Breccia from the New Western Mediterranean Ridge Mud Volcanoes. Abstracts of the 3rd post-cruise meeting, Cardiff, 30 January - 3 February 1995. *MARINF/99*, UNESCO, 1995, 14-15.

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Almendinger, R. Some Features of the Tectonic Structure of the Eratosthenes Seamount Area. Recent Marine Geological Research in the Mediterranean and Black Seas through the UNESCO/TREDMAR Programme and its Floating University Project. Abstracts of the 2nd post-cruise meeting, 31 January - 4 February 1994, Amsterdam. *MARINF/94*, UNESCO, June 1994, p. 22.

Arkhipov, V.E. and Krylov, O.V. Evolution of the Sedimentary Basins on the NW Pacific Continental Margin. EGS-95, Abstracts. Hamburg, 1995.

Basov, E.I. The Black Sea Mud Volcanism. Its Lithology, Geochemistry and Origin. Rapport du XXXIVe Congrès de la CIESM, La Valette, Malte, 1995, Vol. 34, p. 96.

Basov, E.I. Composition of Upper Quaternary Sediments in the Northern Aegean Sea. 14th International Sedimentological Congress, Brasilia, 1994, D-8.

Basov, E.I. The Lithological Composition and Origin of the Black Sea Mud Volcano Breccia. 14th International Sedimentological Congress, Brasilia, 1994, A-4-5.

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Annex 5

RESEARCH PRESENTATIONS AND TRAINING COURSES WITHIN THE 1995 FIELD CAMPAIGN

31 July - 24 September 1995, R/V *Prof. Logachev*, Atlantic Ocean and Mediterranean Sea

31 July	**A. Limonov** – The Mediterranean Sea: a geographical overview.
2 August	**M. Ivanov** – Methods of marine geological-geophysical investigations (Part 1. Seismics)
4 August	**A. Limonov** – Geological structure and history of the Mediterranean Sea
5 August	**M. Ivanov** – Methods of marine geological-geophysical investigations (Part 2. Acoustics)
6 August	**V. Gainanov** – Technique for marine seismic investigations
7 August	**V. Fomenko** – Side-scan sonar "OKEAN": how does it work?
8 August	**L. Akentiev** – Equipment used in the marine seismic survey
9 August	**V. Podshuveit** – Physical-mathematical principles of hydro-acoustics (Part 1)
10 August	**A. Egorov** – Migration and accumulation of hydrocarbons
12 August	**V. Podshuveit** – Physical-mathematical principles of hydro-acoustics (Part 2)
13 August	**A. Egorov** – Hydrocarbon gases in the sea-water and "young" bottom sediments of the world ocean
14 August	**M. Ivanov** – Methods of marine geological-geophysical investigations (Part 3. Sampling)
15 August	**A. Krotov** – Geological-geophysical investigations of the Polar Expedition (Barents Sea, the Atlantic ocean)
16 August	**V. Gainanov** – Digital processing of seismic data **V. Sheremet** – The principles of operation of a TV-guided grab-sampler
20 August	**M. Ivanov** – Mud volcanism in the Mediterranean and Black Seas. **S. Bouriak** – The "Anaxiprobe" project (information).
22 August	**A. Limonov** – General geology of the Mediterranean Sea.
23 August	**E. Ivanova** – Biostratigraphy of the Late Quaternary sediments of the Eastern Mediterranean.
24 August	**G. Akhmanov** – The Mediterranean mud breccia lithology.

25 August	**J.-P. Foucher** – Mud volcano field seaward of the Barbados accretionary prism
26 August	**S. Bouriak, R. Almendinguer** – The "Anaxiprobe 1995" cruise: main goals, methods, equipment and some preliminary results
27 August	**C. Hunt** – Geoscience and the development of the Third World countries (AGID Association of Geoscientists for International Development) **V. Gainanov** – Seismic profiling: methods and data processing
28 August	**W. Ordelman** – The mid-cretaceous sea level project: The Friuci platform **E. Iking** – The mid-cretaceous sea level project: Crimea deep water sections
29 August	**E. Felser** – Cycle terminations in the Western Mediterranean **K. van der Zel** – Late Messinian facies changes of SE Spain (syn- and post-gypsum sedimentation) **L. Dimitrov** – Seismic evidences for shallow gas
30 August	**A. Akhmetjanov** – Mud volcanoes of the Kerch peninsula (Eastern Crimea)
6 September	**G. Akhmanov** – Genetic study of sedimentary rocks (Debate) (Part 1)
7 September	**G. Akhmanov** – Genetic study of sedimentary rocks (Debate) (Part 2)
10 September	**A.Volkonskaja** – Technology and equipment of seismic profiling **E. Karpekin** – TTR-5 cruise seismic data pre-processing
11 September	**T. Efimova** – The principles of work of the TV-grab; some results of geological sampling
13 September	**A. Stadnitskaya** – General methods of geochemical sampling

The logo of the 5th "Training-through-Research" cruise (1995) (Artwork: A. Akhmetjanov)