Floating University Facility

Training-through-Research Programme

10th Anniversary

Intergovernmental Oceanographic Commission

Annual Report, 2000

Activities described in this Report represent part of the international 'Training-through-Research' (TTR) programme and its 'Floating University' facility. Chapter 1 presents the history and account of this international endeavour. Chapter 2 presents the history and account of activities executed through the UNESCO-MSU Research and Training Centre for Marine Geosciences established at Moscow State University (MSU) specifically for the TTR implementation. For the above reason, other Chapters refer mostly but not exclusively to the activities executed in 2000 by, or with the participation of, researchers and students from the Centre, as well as to those of the UNESCO-MSU Chair in Marine Geosciences, its training 'arm'. Most of the TTR activities are inter-linked and inter-dependent. Given the international co-operative nature of the TTR programme, this document reports in fact on projects jointly executed by many partners. The equally important role of all co-operating parties from many countries in the implementation of the TTR programme is fully recognized and highly appreciated.

TTR (Floating University) is registered by the Union of International Associations (www.uia.org) under #F3418 (see the Yearbook of International Organizations Guide for Global Civil Society Networks and http://db.uia.org/scripts/sweb.dll/uiaf?DD=OR&DR=F3418).

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Training-through-Research Programme:
10 years of international co-operation (1991-2000)

…its concept

To foster an international community of young scientists, well trained, coming from a variety of nations and cultures but appreciating their differences and gaining from them, capable of handling advanced equipment and managing high-quality scientific data, collected and interpreted under the guidance of leading professionals from universities and academic institutions, getting involved in publication of scientific papers.

…its history

In the year 2000, the Training-through-Research (TTR) programme marked its 10th Anniversary. The journey between its formulation and official launching took several years.

An initiative of Moscow State University (MSU), the programme's seeds had been sown during discussions at a UNESCO workshop on 'Year 2000 Challenges for Marine Science Training and Education World-wide' (Paris, 1988) and in particular, grew up from the recommendations of the UNESCO workshop on 'University Field Courses in Marine Sciences' (Moscow and Poyakonda, 1989), organized by MSU.

In March–May 1990, the 'training-through-research' approach was tested by a small international group of scientists during a research cruise of the MSU R/V *Akademik Petrovskiy* to the Mediterranean Sea.

The same year, UNESCO sent (June) three members of the MSU Faculty of Geology (M. Ivanov, A. Kalinin and V. Trofimov) and a UNESCO representative (D. Krause) on mission to a number of universities and marine institutions in the Netherlands, Norway and France with a view to testing the grounds for co-operation between marine science educators and researchers of Western and Eastern Europe. This mission resulted in an exchange of letters of understanding and memoranda for co-operation signed by the prospective partners.

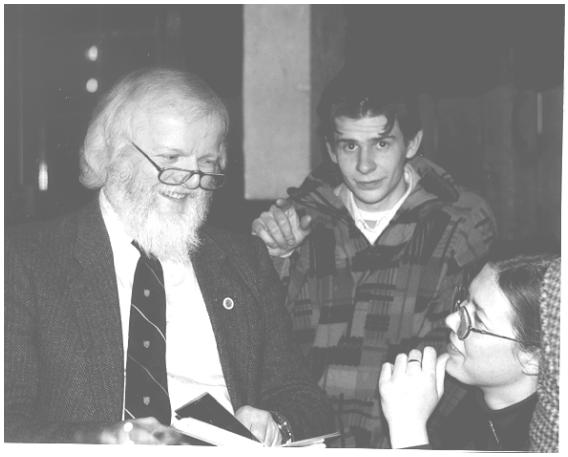
M. Marani (center) with M. Ivanov (second from the left) on board the Petrovskiy, *1990*

TTR finally blossomed in the summer of 1991 from buds that sprouted during a workshop, which was hosted, between 12–14 December 1990, by the Institute of Marine Geology in Bologna, Italy. Those attending the founding event were: J. Mascle (France), R. Rihm (Germany), Z. Ben-Avraham (Israel), F. Frascari and M. Marani (Italy), J. Woodside and Tj. van Weering (Netherlands), K. Burdin, M. Ivanov and A. Kalinin (Russia), Y. Larchenkov (Ukraine) and D. Troost (UNESCO). The workshop endorsed a proposal to organize, in 1991, the first 'Floating University' international geological-geophysical cruise in the Mediterranean and Black seas, with both training and research aims. UNESCO agreed to fund this and the following cruises, through the Organization's Training and Education in Marine Sciences (TREDMAR) programme. It is for this reason that the first TTR cruises have been referred to in a number of publications as 'TREDMAR cruises'.

The Professor Logachev *at sea*

The Bologna workshop had a historical significance for the TTR programme as it struck a balance between the immediate needs for training Russian students in the years when the 'iron curtain' was starting to lift and additional facilities for marine geoscience research for West European scientists. This followed an offer by the Ministry of Natural Resources of Russia to use the R/V *Gelendzhik*, one of its new and well-equipped research vessels. This vessel, together with her sister-ship R/V *Professor Logachev,* has become the platforms for the 'Floating University' facility of TTR. The Bologna workshop succeeded in combining the two seemingly uncompromising needs for education and research and formulated the concept that is reflected now in the programme title, 'Training-through-Research'.

Between 1992–1994, the critical launching period, TTR was co-sponsored by the European Science Foundation through its Network on Advanced Study Workshops on Mediterranean Marine Geosciences (the Network and TTR Co-ordinator was Dr. John Woodside, Free University of Amsterdam).



John Woodside, TTR Co-ordinator (1991-1996) with the MSU students, 1995

During this initial period, very important support was also provided by the Netherlands Marine Research Foundation, SOZ (through Dr. Jan Stel).

In 1993, TTR with its Floating University facility was officially included in the UNESCO programme, reflected in the decisions of the 27th session of the UNESCO General Conference (1993). Up until the end of 1995, UNESCO continued providing support through the TREDMAR programme (terminated on 31 December 1995 due to rearrangements in the UNESCO programme).

UNESCO Director-General (1987-1999) Federico Mayor visits Moscow State University with Victor Sadovnichiy, MSU Rector (center) and Mikhail Ivanov (left), 1998

Following a proposal by UNESCO in 1993, the UNESCO-MSU Centre was established at the MSU Geology Faculty to specifically develop the TTR programme and, in 1994, following the UNESCO-MSU agreement, a UNESCO Chair in Marine Geosciences was established within the Centre to serve as its training 'arm'.

Since 1996, the programme has been co-sponsored by the Intergovernmental Oceanographic Commission (Resolution XVIII-14 adopted at the 18th Session of the IOC Assembly, 1996) through its Training, Education and Mutual Assistance (TEMA) component.

…its advantages

TTR combines the advantages of the formal training of students and young scientists with the experiences from advanced research in marine geology, geophysics and — more recently — benthic biology. It provides shipboard training but is not limited to the latter, which makes it different from traditional on-

Discussion of the cruise data with the students on board the R/V Gelendzhik, *1991*

the-job training programmes. The annual TTR cycle of activities includes:
(i) preparation of an international TTR cruise by the Executive Committee;
(ii) the TTR cruise that combines an extensive research programme, on-the-job training and daily lectures and seminars for students. When possible, it includes a mid-cruise workshop and/or field excursion for the participants and invited scientists;
(iii) following the cruise, extensive exchange of participants, additional data collection, and data processing;
(iv) a post-cruise conference to present and discuss the results of on-going analyses and interpretation of data, and to co-ordinate with other regional studies; and
(v) preparation of scientific reports and publications.

Members of the TTR Executive Committee (as was in 1997) N. Kenyon (Co-ordinator), J.P. Henriet, M. Marani, G. Kullenberg (IOC Executive Secretary, 1989-1998), M. Ivanov and J. Woodside (from left to right) in UNESCO, 1997

The recognized flexibility of the TTR programme in selecting the research targets is of direct assistance to a number of important international undertakings, including ODP, EC-MAST, etc. It also answers the needs of the offshore oil industry for preliminary geo-technical and environmental investigations.

…its management and funding

The Executive Committee (Co-ordinator: Dr. Neil Kenyon, Southampton Oceanography Centre, UK) manages the TTR programme. Its Scientific Committee is responsible for formulating the longer-term research tasks. IOC assists the programme at its various stages.

UNESCO Assistant Director-General for IOC and TTR-EC Member Patricio Bernal visits MSU with Boris Sokolov, Geology Faculty Dean (left), Victor Trofimov, MSU Vice-Rector (next to him) and Andrey Akhmetzhanov, a (then) MSU Ph.D. student (right), 1999

Co-funding is the basic principal and the basis of the programme's successes. A small but indispensable contribution comes from IOC (as it did from UNESCO/TREDMAR earlier), mostly in support of the programme's operational activities (such as contributions to students' travel to attend TTR meetings, to produce initial reports for publishing by IOC, etc.) but also to help fund the involvement of researchers from developing countries in the TTR cruises.

These catalytic funds produce, however, a 'snow-ball effect'. During the last ten years, many research activities and field operations have been covered from national funding sources of the participating countries, such as Belgium (specifically the Flemish Government), Denmark, France, Germany, Ireland, Israel, Italy, Portugal, the Netherlands, Russia,

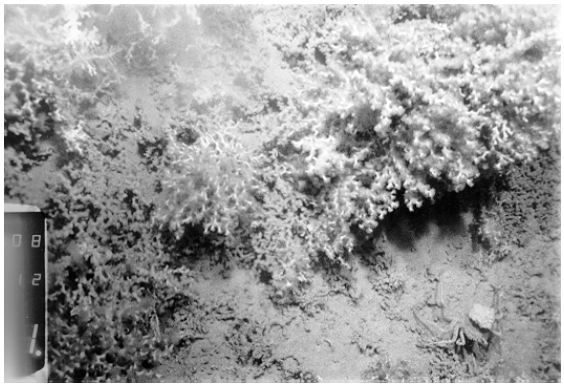
Spain, Switzerland, Turkey, UK and USA), as well as from international projects (e.g. the Ocean Drilling Programme) and European research projects. The International Hydrographic Bureau (Monaco) has also provided support. Funds for offshore operations have come from oil companies with a direct interest in research results from specific geographical areas.

…its account

In the period 1991-2000, ten annual TTR cruises (totaling 480 days at sea, including 377 working days) were conducted in the Mediterranean and Black seas, and in the northern Atlantic on board the two sister-ships, R/Vs *Gelendzhik* and *Professor Logachev*. During the cruises, nearly 33,000 km of seismic profiles were recorded (in addition to other geophysical data), 613 bottom samples taken and some 30 km of underwater TV profiles registered.

Over 500 scientists and students have taken part in the annual cruises. They hailed from 27 countries scattered around the North Atlantic, Mediterranean-Black Sea region, with a few from further afield. These countries are: Algeria, Belgium, Brazil, Bulgaria, Chile, Denmark, France, Georgia, Germany, Greece, Ireland, Israel, Italy, Morocco, the Netherlands, Pakistan, Poland, Portugal, Russia, Saudi Arabia, Spain, Switzerland, Tunisia, Turkey, Ukraine, United Kingdom and USA.

Eight post-cruise conferences were held in Moscow (1993 and 1996), Amsterdam (1994 and 1997), Cardiff (1995), Gent (1998), Southampton (1999) and Granada (2000). A number of other field exercises (including smaller cruises and thematic field workshops),



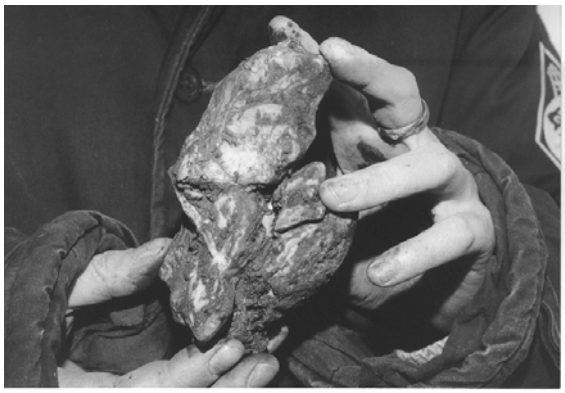
Deep-water corals (from an underwater TV profile), North Atlantic, TTR-7 cruise (1997)

Students at work on board the Gelendzhik*, TTR-4 cruise (1994)*

group and individual training activities, and presentation and publication of the research results were carried out, all contributing to TTR.

All together, 73 universities and research institutions have become involved in the TTR field operations and well over 100 institutions have taken part in all forms of the TTR co-operation, including students' training, workshops, TTR conferences, etc.

Among the research achievements of the TTR programme are:
(i) discovery and detailed study of many mud volcanoes and mud-volcano provinces on the floor of the Black and Mediterranean seas and in the NE Atlantic, and advancement of knowledge about their origin;
(ii) advancement of knowledge about the geometry of deep-sea sedimentary depositional systems and their processes of formation on continental margins;
(iii) advancement of knowledge about gas hydrates and gas and fluid flow through the sediments;
(iv) studies of giant carbonate mounds and their relation to cold-water corals.



Gas hydrates from the Black Sea floor, TTR-6 cruise (1996)

TTR provides added value to European programmes, as in the study of impacts on the deep-ocean biosphere, with a view to its preservation, studies of bottom environments and ecosystems that are controlled by strong bottom currents. Indeed TTR has helped to trigger some of the latest European programmes.

The TTR research results have been reported in some 30 peer-reviewed publications, including two special issues of the *Marine Geology* (1996) and *Geomarine Letters* (1998) international journals, as well as in several hundred other types of publications (UNESCO and IOC reports, abstracts of papers presented at international meetings, etc.).

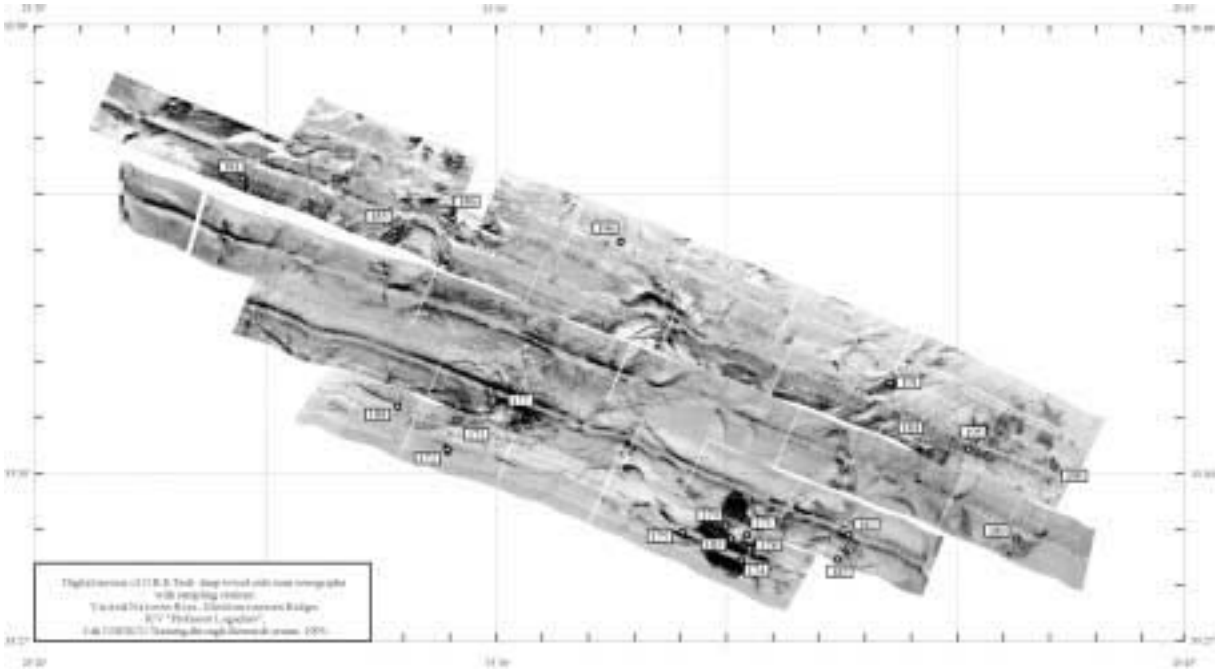
Over ten Ph.D. and D.Sc. dissertations have been defended based on the TTR results, in addition to tens of M.Sc. and B.Sc. projects.

Last but not least, is that after ten years of operations, the TTR programme may report that it has reached its primary objective: many young, well-trained specialists continue successfully working in the marine geoscience field — in universities, research institutions, geophysical companies and oil industries. Some of those students, who first attended one of the TTR cruises years ago, have returned as experienced teachers and supervisors of students' projects and as co-chief scientist.

…its recognition by the United Nations

In recognition of its achievements and in particular its contribution to building international peace and tolerance - fundamental objectives of the United Nations - the programme was included, in 1995, in the List of Events for the celebration of the UN's 50th Anniversary.

In the same year, a hitherto unknown positive relief feature was discovered in the Mediterranean Sea by the TTR-5 cruise and was given the name 'the United Nations Rise'.



The United Nations Rise as seen on the O.R.E.Tech digital mosaic, TTR-5 cruise (1995), and sampling stations

UNESCO-MSU Centre:
an overview

…its history

The UNESCO-MSU Research and Training Centre for Marine Geology and Geophysics was established (on proposal by UNESCO) in April 1993 on the decision of the Rector of Moscow State University academician, professor V. Sadovnichiy. UNESCO Director-General Federico Mayor, thus consolidating UNESCO's ongoing support, endorsed the act on 4 February 1994. Dr. Michael Ivanov was nominated Director of the Centre.

The establishment of the Centre was strongly encouraged by a number of European universities and individuals who were at the origin of and became involved in the TTR programme. Among these the most active support was provided by: Free University of Amsterdam (John Woodside), Marine Research Foundation of the Netherlands (Jan Stel), the Netherlands Institute for Sea Research (Tjeerd van Weering), Institute of Marine Geology, Bologna (Michael Marani), University Paris-VI (Jean Mascle), University of Milan (Maria Bianca Cita), Southampton Oceanography Centre (Neil Kenyon), University of Wales, Cardiff (Robert Kidd), Dokuz Eylul University, Izmir (Mustafa Ergun) and a team from the UNESCO Division of Marine Sciences (Dale Krause, Marc Steyaert, Alexei Suzyumov, Dirk Troost and Gary Wright). At the national level, among the enthusiastic supporters were Ivan Glumov (Deputy Minister, Ministry of Natural Resources), Victor Trofimov (Vice-Rector, MSU), Arkady Kalinin (Chief, Department for seismic and geoacoustics, MSU), Vassily Zhivago (Ministry of Science, Industry and Technology) and Boris Sokolov (Dean, Faculty of Geology, MSU).

M. Ergun, N. Kenyon, M. Comas, J. Mascle and M.B. Cita (from left to right) at the 5th TTR Post-cruise Conference in Russia

Moscow State University (main building) - the UNESCO-MSU Centre is situated at the 6th floor

…its mission

Affiliated with the MSU Geology Faculty, the Centre aims to support research projects of undergraduate and post-graduate students. Its scientific and educational activities are based on international co-operative programmes involving universities and research institutions from many countries. Within MSU, it co-operates with the majority of the Geology Faculty Departments and ensures the necessary marine science-related training. At the national and international levels, co-operation was established with many institutions (nearly 30 in 2000 only, Annex I).

…its structure and services

The Centre has three branches:

(i) Marine Geology and Sedimentology (including Micropaleontology);
(ii) Seismics and Geo-acoustics; and
(iii) Geochemistry.

It provides various laboratory and computing facilities to the staff and students and is supported by the MSU central services, such as

libraries, analytical laboratories, Science Park, etc. It is supported by the efficient services of the offices of the Geology Faculty Dean and the University Rector.

…its funding

In 2000, funds for research and training were provided by MSU, Russia's Ministries of Natural Resources; Industry, Science and Technology; and Education, and also by the Flemish Government, Belgium (through the MSU-Gent University Agreement for co-operation and bilateral project, funded by Flandres), the Netherlands (through a bilateral Agreement with NIOZ, 1998-2000), France (through the MSU-University Paris-VI Agreement first signed in 1993), the IOC and other sources. The joint field operations were also funded in 2000 by several more sources (see next Chapter). This support is sincerely acknowledged.

…its operation

The Centre is the principal organizer of the TTR cruises: it negotiates with Russia's Ministry of Natural Resources (the ship-owner) all the conditions for the use of a research vessel with its equipment for international 'training-through-research' cruises. It also negotiates bilateral agreements for co-operation with other institutions and, jointly, launches and executes research projects. MSU provides the staff of the Centre.

…its account

Between 1991–2000, the Centre co-organized, with international counterparts, ten major TTR cruises in the Mediterranean and Black seas

A group of the TTR-6 cruise participants (1996)

G. Akhmanov presents his Ph.D. thesis to the jury of the Geology Faculty, MSU

and in the North Atlantic, and assisted in the organization of a few smaller cruises. Among more than 500 participants (not counting technical support staff and crew) in the ten TTR cruises, around 200 were from MSU.

Two TTR conferences, in 1993 and 1996, were organized and hosted by the Centre. It also organized and supported the participation of over 120 MSU researchers and students in these and other TTR conferences, not counting the attendance at over 50 national and international fora, such as assemblies of the European Geological and Geophysical Societies, European research conferences, CIESM congresses, etc.

The Centre has promoted many research and training projects and provided - directly or through various arrangements - a considerable number of research and training fellowships (from a few weeks to one year long) to MSU scientists and students for their advanced research and studies abroad.

Five Ph.D. students from the Centre have received (on a highly competitive basis) grants from the President of the Russian Federation for their one-year-long studies in leading research institutions abroad.

In 1994, two MSU students, who had been actively involved in the TTR programme, received from the Dutch Government 4-year fellowships for studies (hosted by the Free University of Amsterdam) leading to Ph.D. degrees (successfully defended). Three more Ph.D.'s and two D.Sc. dissertations were successfully defended at MSU in the last four years.

Research and Training Activities:
the UNESCO-MSU Centre, year 2000

Research projects

In 2000, eight post-graduate and ten undergraduate students from various departments of the MSU Geology Faculty were involved, on a permanent basis, in the research projects of the Centre. About 20 undergraduate MSU students have become involved in the Centre's training activities. A number of research projects, mostly of regional nature, were continued. They were carried out in co-operation with national and foreign universities and research institutions, and included such topics as:

– Deep-sea depositional systems in the NE Atlantic;
– Hydrocarbon gas composition in cold vents;
– Authigenic carbonate mineralization due to CH_4 oxidation in anoxic environment;
– Pore water composition in fluid venting areas;
– Reconstruction of geological sections through study of the lithology and fossils in mud volcanic deposits;
– Composition of organic matter in recent sediments and mud volcano breccia;
– Composition and maturity of organic matter in sedimentary rock clasts of mud volcano breccia;
– Carbonate mud mounds and their relationship with cold vents;
– Gas hydrates accumulations and related phenomena;
– Hydrothermal processes and sulphide deposits at the Mid Atlantic Ridge;
– Megaturbidite composition and origin; and
– Modern analogues of deep-water hydrocarbon reservoirs.

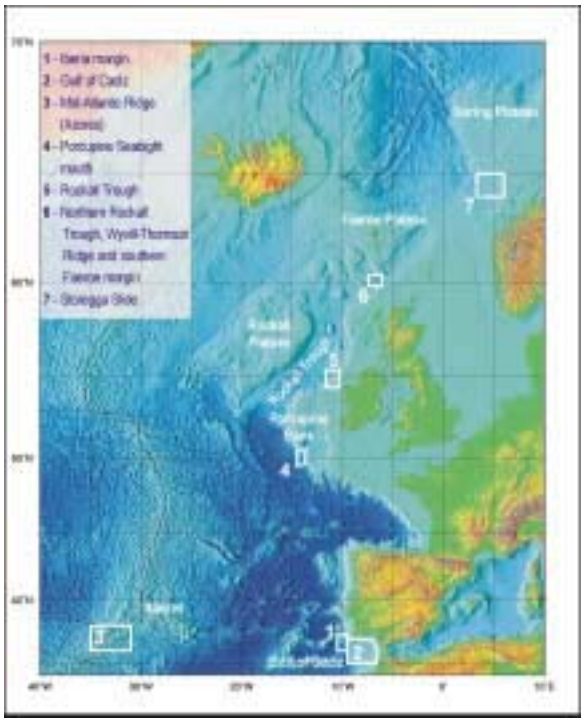
Field operations

The Training-through-Research strategy was applied during the major TTR-10 cruise in the Atlantic Ocean (R/V *Professor Logachev*, Russia), and, on a smaller scale, during other international cruises: the R/V *Belgica* (Belgium), the R/V *Pelagia* (the Netherlands) and another *Logachev* cruise (all to the North Atlantic).

An international field workshop to an area of mud volcano development (Kerch peninsula, the Crimea, Black Sea region) was organized in the summer of 2000 jointly with the National Academy of Sciences of the Ukraine and Gent University (Belgium). The purpose was to show on-land mud-volcano structures to students, as an analogy to sea-bottom structures that have been widely studied within the TTR programme.

The Kerch (Crimea, Ukraine) mud volcanic field: an exposed small-scale analogy of sea-bottom structures

TTR-10 'Floating University' cruise: studies of the European continental margins and the Mid-Atlantic Ridge



TTR-10 cruise map

The TTR-10 cruise was carried out on board R/V *Professor Logachev* (Russia, captain Alexander Arutyunov) from 13 July to 28 August. The Ministry of Natural Resources of Russia owns the ship.

The cruise started from Santa Cruz de Tenerife (Canary Islands, Spain) and ended in Bergen (Norway). It was subdivided into three legs with two intermediate port calls, where partial exchange of the Scientific Party was made: in Cadiz (Spain) on 24-25 July and in Ponta Delgada (Azores Islands, Portugal) on 7-8 August.

TTR-10 participants, Leg 2

The Co-Chief Scientists of the cruise were:
– Leg 1: Luis Pinheiro and Mikhail Ivanov,
– Leg 2: Jose Monteiro and Mikhail Ivanov,
– Leg 3: Andrey Akhmetzhanov and Mikhail Ivanov.

An international team of 58 scientists, post- and undergraduate students from 10 countries (Belgium, Brazil, Georgia, Italy, Morocco, Portugal, Russia, Spain, Switzerland and the UK) participated in the cruise (in addition to a group of Russian technicians who had been working with the *Logachev* equipment) (see Annex II).

Training objectives

The training objectives of the cruise were to provide students with training in marine geo-science research. During the cruise, the participating students were actively involved in all

Luis Pinheiro lecturing at a shipboard seminar

stages of acquisition and preliminary processing of a multidisciplinary set of data. Daily seminars, lectures and discussions on the data, that had been collected (Annex III), facilitated high-level on-the-job training.

Research objectives

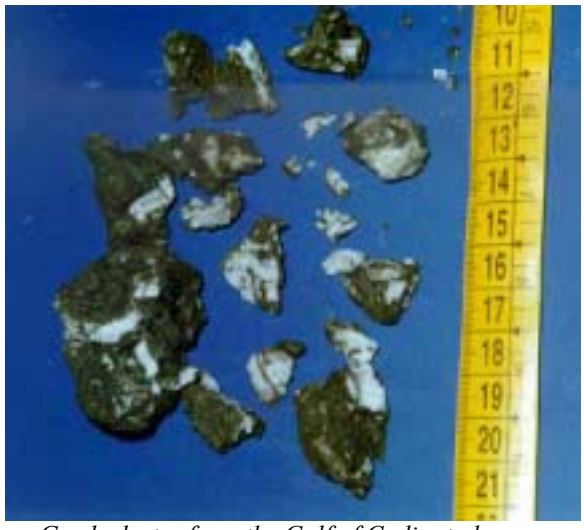
The research objectives of the cruise were to study geological processes on continental margins and at the Mid-Atlantic Ridge. The scientific programme of the expedition included research works in seven areas located on the Portuguese Margin (Marques de Pombal Fault Zone), in the Gulf of Cadiz, in the Lucky Strike area of the Mid-Atlantic Ridge, on the Rockall Trough, the Faeroe margins and on the Vøring Plateau of the Norwegian Margin.

Funding and logistic support

Besides IOC sponsorship, financial support for the cruise was provided by the 'Instituto Geologico e Mineiro' (Portugal), Southampton Oceanography Centre (UK), GEOTEK Co. (Ireland), Commission for Oceanography and Limnology (Switzerland), in addition to national funding from Russia's Ministries of Natural Resources and Industry, Science and Technologies. Logistic support was provided by the Netherlands Institute for Sea Research (NIOZ), which co-ordinated the financial input from the co-operating partners and provided administrative support to the expedition. In this respect, sincere gratitude is due to Prof. J. de Leuw, the Director, Dr. M. Rietveld and Dr. M. van Arkel.

TV-guided grab brings a sample from the deep

Studying hemosynthetic benthic fauna from a black smoker, Lucky Strike area (Mid-Atlantic Ridge)



Gas hydrates from the Gulf of Cadiz study area

Equipment

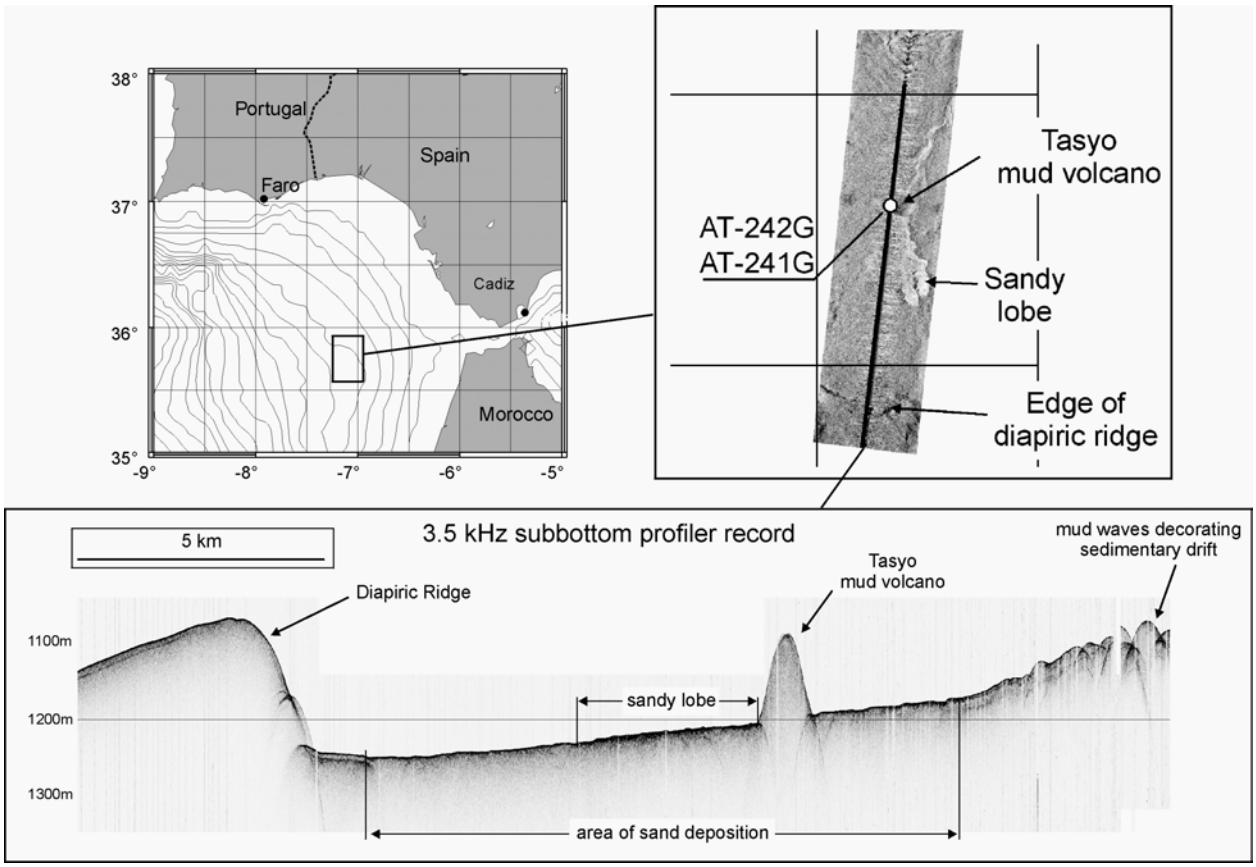
The equipment used for the research included: a single-channel high-resolution seismic system with airgun sources, an OKEAN long-range side-scan sonar, a hull-mounted 3.5 kHz profiler, an O.R.E.tech deep-towed system containing a high- to middle-resolution side-scan sonar and a 7 kHz sub-bottom profiler. For more detailed studies, a 6 m gravity corer, a CTD system, a new TV-controlled grab and a dredge were all used.

The cruise summary[1]

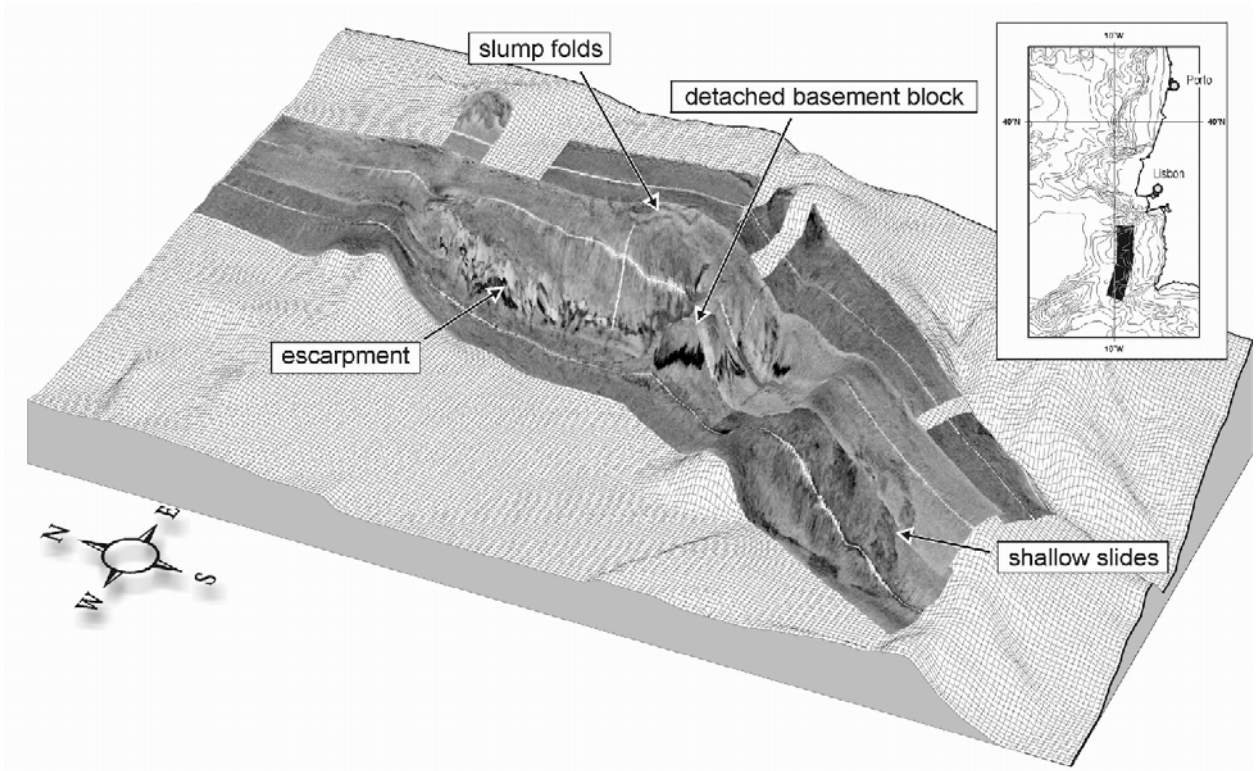
Area 1: Gulf of Cadiz

The area of the Gulf of Cadiz has recently become of substantial scientific interest to a number of researchers. Neotectonic processes and the vigorous Mediterranean Undercurrent sweeping the continental margin are major issues for most of the projects operating in the area. The former causes the development of numerous clay diapiric structures with associated mud volcanoes and fluid escape features. The Mediterranean Undercurrent affects, to a large extent, the sedimentation pattern in the area and is responsible for mobilization, transport and deposition of large volumes of sand along and down the continental slope. A survey, with the 3.5 kHz profiler, seismics and long-range side-scan sonar, was performed within one of the downslope running channels cut by the Undercurrent, allowing a better under-standing of its configuration. Areas of cold seeps and gas venting and several mud volcanoes were discovered and mapped with seismics, the 3.5

[1] Provided by the ship-board party



OKEAN long-range sidescan sonar image and 3.5 kHz subbottom profiler records from the Gulf of Cadiz showing interaction of two characteristic for this region processes: mud diapirism/volcanism and strong, bottom contour current activity



OKEAN long-range sidescan sonar image draped over the bathymetry from the area west of Iberia. The OKEAN survey revealed a number of features related to recent active tectonic regime

kHz profiler and a long-range side-scan sonar. Six of these structures were confirmed by various core samples and unique material was collected for further analytical processing. At the top of some of the mud volcanoes deep-water corals were found associated with chemosynthetic communities. Gas hydrate samples were obtained from two structures. Additional investigations were performed in a mud volcano field discovered during the TTR-9 cruise in 1999.

Area 2: Marques de Pombal Fault Zone

The TTR-10 cruise extended studies at the adjacent parts of the Portuguese continental margin conducted during the TTR-8 (1998) and TTR-9 (1999) cruises. A number of seismic lines and side-scan sonar profiles were carried out to clarify the depositional environment in the active tectonic zone and the recent tectonic situation in the area. A structural map of this part of the margin was compiled. Studies of the main structural elements of the margin and of recent fault activities were the main interest of investigations together with turbidite sand bodies deposited in the tectonically active area. Some of the turbidites known in this area are possibly related to a catastrophic Lisbon earth-quake (1755), and the Marques de Pombal Fault is suspected to be responsible for this event.

Area 3: Mid-Atlantic Ridge southwest off the Azores (Lucky Strike field)

The area is characterized by the presence of numerous hydrothermal vents and is one of the largest underwater sulfide ore fields in the world. The main task of the study was to investi-gate relations between volcanic and tectonic structures in the area, and the distribution of hydrothermal activities leading to sulfide ore formation. A sampling programme based on the previous detailed sidescan sonar and video

Students documenting cores

Alvero Pinto and Isabel Gomes Teixeira studying a piece of a chimney from the Mid-Atlantic Ridge

observation and mapping was carried out with a TV-controlled grab. Spectacular video-footage of ore build-ups, hot vents and chemosynthetic communities was obtained. An extensive collec-tion of sulfide ores of different types, igneous rocks and bottom fauna was retrieved. O.R.E.-tech side scan sonar profile was obtained across the central volcanic plateau of the Lucky Strike filed.

Area 4: Porcupine Seabight

The main scientific interest in the area was to investigate the Gollum system of underwater channels, which is one of most continuous turbi-dite channel systems on the northeastern Euro-pean continental margin. The work undertaken during the TTR-7 cruise in 1997 showed that the system was not active recently. Year 2000 studies were focused on the lower reaches of the system, where 3.5 kHz profiling was conducted in order to check the presence of shallow buried turbidite sand bodies at the most distal part of the system.

Dennis Miller (center) discussing seismic data with students

Area 5: Rockall Trough

The increase in oil exploration activities in deep-water parts of the European continental margin require environmental surveys, which were undertaken on the Rockall Trough margins between 1996–99 on the TTR programme. As a result, an extensive set of side-scan sonar data was obtained providing a detailed picture of modern geological processes taking place there. The development of downslope running canyon systems and slope instability features are the most important issues in the area. During the TTR-10 expedition, a hitherto poorly known canyon system was studied with seismics, the 3.5 kHz profiler, and two types of sidescan sonar. Bottom sampling aimed to sedimentologically characterize different parts of the system and to ground-truth acoustic facies observed at different frequencies, for a better understanding of the nature of the system, its evolution and current geological environments.

Area 6: Northern Rockall Trough, Wyvill Thomson Ridge, and Faeroe-Shetland Channel

The area is of importance to a number of oil companies and requires environmental surveys in areas of potential exploration. Investigations during the TTR-10 cruise were done in three sub-areas. Area 6a represents a field of carbonate mud mounds discovered during a survey done by the Southampton Oceanography Centre in 1998. Carbonate mounds were studied with a bottom TV system, and bottom samples were retrieved from mounds. Areas 6b and 6c are characterized by the development of coarse glacial lag deposits on the seafloor as well as outcropping Tertiary rocks. Extensive bottom sampling with a TV-controlled grab was done there and a representative collection of samples of bottom sediments and epifauna was obtained with visual control of sampling sites.

Area 7: Storegga Slide and Vøring Plateau

The area is located at the northern edge of the giant Storegga Slide and extends to the southwestern edge of the Vøring Plateau. Previous expeditions (including the R/V *Logachev* cruise in 1994 and the TTR-8 cruise in 1998) discovered numerous fluid escape features there. Analysis of seismic profiling data led to the assumption that there are gas hydrate accumulations in the upper part of sedimentary succession. The year 2000 study was conducted in the area to understand better how fluid escape features and gas hydrates accumulations can affect slope instability processes. The distribution of a bottom-simulating reflector (BSR) below displaced sediments of the Storegga Slide was traced by seismic profiling. Video recordings of the seafloor were made and samples taken in zones of fluid discharge onto the seafloor.

The overall conclusion by the TTR-10 cruise participants is that, in 2000, the Training-through-Research programme carried out very successful field operations in its traditional research areas on the NE European continental margins, as well as, for the first time, at the Mid-Atlantic Ridge.

Other TTR-related cruises

R/V Belgica

The TTR approach was partially realized in a few other cruises carried out in 2000. These were:
(i) the *Belgica* (Belgium) international cruise (25 May–10 June) to the Porcupine Seabight and the Rockall Bank, with the participation of 13 researchers and students from Belgium, Ireland and one young researcher from MSU (Russia);
(ii) the *Pelagia* (the Netherlands) international cruise (24 July–1 September) to the Porcupine Seabight, the Rockall Bank and the Faeroe continental margin with the participation of some 20 researchers and students (in two legs) from Denmark, Ireland, the Netherlands and the UK, including two students from MSU (Russia);
(iii) the 'Knipovich-2000' international cruise of the *Logachev* (Russia) to the south-west of Svalbard (30 August–24 September), attended by one student from MSU (Russia).

These cruises have provided additional opportunities for students and young scientists in on-the-job shipboard training and research.

TTR-10 cruise logo

UNESCO Chair

In accordance with the UNESCO-MSU Agreement (signed in 1994), the UNESCO Chair in Marine Geology and Geophysics continues to function as part of the UNESCO-MSU Centre for Marine Geosciences, providing educational support to its research projects (Chair holder Prof. Michael Ivanov). Particular attention has been paid to group training and supervision of Ph.D. and undergraduate projects. Students who have been carrying out their research in the MSU laboratories, as well as in a number of research institutions in Russia and abroad (through bilateral co-operation agreements), use data obtained during the TTR expeditions.

Group training

Well before the TTR expedition started, students interested in the marine geoscience research began working in the laboratories and the MSU Science Park to learn the objectives of a particular expedition, to become acquainted with the geology of the study areas, the geological and geophysical methods to be used, and the equipment. The selection of students for participation in the TTR-10 cruise was based, as always, on candidate submissions from the various departments (such as Geology and Geochemistry of Fuel Minerals, Lithology and Marine Geology, Geophysics, Paleontology, etc.) and on the students' personal achievement during the preparatory phase. The selection of the best candidates is necessary in view of the limited number of places on board and to implement, in the best possible way, the research programme.

Those selected were given a series of lectures and seminars related to the subject of the cruise (March–May). Another series of seminar presentations took place onboard the *Logachev* during the TTR-10 cruise (see Annex III) and yet another was given in December, in preparation for the TTR-10 Post-cruise conference (30 January–3 February 2001, Moscow).

Individual training and research activities

Irina Belenkaya, an MSU post-graduate student started, in 2000, a research project on authigenic mineral formation in deep-water gas-saturated sediments, based on a collection of samples gathered during the TTR cruises, in co-operation with University Paris-VI (Dr. Catherine Pierre). The project and 10-month-long fellowship (started in May) in the 'Laboratoire d'océanographie dynamique et de climatologie', Paris, was funded from a grant by the President of the Russian Federation to best Ph.D. students.

Elena Kozlova, a researcher from the MSU Geology Faculty visited (25 October-1 December) the 'Laboratoire de Stra-

Elena Kozlova working in the 'Laboratoire de Chimie Bioorganique et Organique Physique'

tigraphie', University Paris-VI and the 'Laboratoire de Chimie Bioorganique et Organique Physique, Ecole de Chimie', CNRS (France), where, in co-operation with Dr. F. Baudin and Mr. C. Largeau, she continued Ph.D. studies on organic matter in rock clasts from mud volcano breccia collected during the TTR-9 and TTR-10 cruises in the Gulf of Cadiz.

Dmitri Ovsyannikov, an MSU student, took part in the 'Knipovich-2000' international cruise of the R/V *Logachev*, which immediately followed the TTR-10 expedition. The cruise (30 August- 24 September) was devoted to studies of the Knipovich Ridge southwest of Svalbard. It was organized and funded by the Ocean Research Institute, the University of Tokyo (both Japan) and VNIIOkeangeologiya (Russia). The expedition studied the tectonics of this ultra-slow seafloor spreading system, its active hydrothermal vents, and magmatism and microearthquake activity along the Ridge. D. Ovsyannikov, who participated in the expedition on the Russian quota, in exchange for a VNIIOkeangeologiya specialist who took part in the TTR-10 cruise, was specifically involved in studies of sedimentary processes in the rift valley in relationship to the tectonic evolution of the Knipovich Ridge.

Aleksey Sadekov, an MSU undergraduate student, was granted a fellowship to work (July to October) at the Netherlands Institute for Sea Research (NIOZ) in the framework of the MSU-NIOZ co-operation agreement. His work was done under the supervision of Dr. Tj. van Weering and included participation in the R/V *Pelagia* international cruise (24 July to 1 September) in the Porcupine Basin and-Rockall Bank. The main subject of these investigations was to study the morphology of the carbonate mud mounds and the processes that could lead to their creation on the sea floor. The data obtained during the cruise were later processed at NIOZ to study the distribution of benthic foraminifers around the carbonate mounds on the NE Atlantic margin.

Eugeny Petrov, an MSU undergraduate student, also visited the Netherlands Institute for Sea Research (NIOZ). He participated in the R/V *Pelagia* international cruise (24 July to 1 September) in the Porcupine Basin and Rockall Bank, after which he processed (September–October) multichannel seismic data acquired during the cruise, under the supervision of Dr. Tj. van Weering.

Anna Volkonskaya, an MSU Ph.D. student, visited the Marine Geology Department of the Geological and Mining Institute (Lisbon, Portugal, 15 April–18 May). She shared her experiences with a group of Portuguese scientists and, under the supervision of Dr. Luis Menezes Pinheiro, processed the multi-channel seismic data collected during the TTR-9 cruise on the Portuguese margin. The pre-processing analysis of the data obtained pointed out several artifacts, which made most standard processing procedures not applicable to the data. The main task of her work was to study the origin of these artifacts and develop a special processing flow to improve the data for interpretation.

She also visited the 'Laboratoire de Géodynamique sous-marine', Villefranche-sur-mer, France (19 May–15 June) where, under the supervision of Dr. Jean Mascle, she tested a new seismic package processing system, Geovector, purchased recently by the Laboratory, and reprocessed some of the data collected in 1998, during the PRISMED cruise on the R/V *l'Atalante* in the Eastern Mediterranean (where she participated). The visit was arranged in the framework of the co-operation agreement between MSU and University Paris-VI.

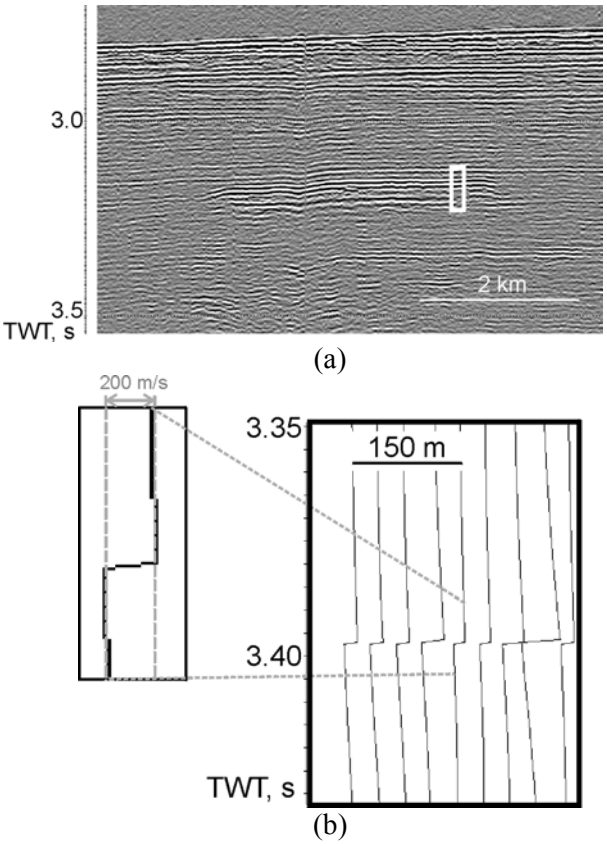
Pavel Shashkin, a researcher from the UNESCO-MSU Centre, participated in a cruise on the R/V *Belgica* (Belgium) to the Porcupine Seabight (25 May–7 June). This was in accordance with the bilateral co-operation agreement between Gent University (Belgium) and MSU. Thirteen scientists from Belgium, Ireland and Russia attended the cruise. High-resolution seismic surveys in the carbonate mound area and on the Irish continental slope were carried out. Also some successful tests of a new underwater seismic system and biological sampling with a box corer were done. After the cruise P. Shashkin continued the work under the joint MSU-University of Gent project developing educational multimedia CD-ROM.

Dissertation defended

'Application of High Resolution Single-Channel Seismic Profiling in Shallow Gas Studies' was the subject of a Ph.D. dissertation successfully defended on 17 May by S.V. Bouriak, presented to the jury of the Geology Faculty (MSU). The study was based on the results of several years of geophysical investigations in the TTR framework.

Principal seismic indicators of shallow gas, as observed on high-resolution single channel records, were determined based on their physical nature, and summarized to facilitate visual interpretation of single-channel seismic data. In order to increase the reliability of the interpretation, as well as to obtain quantitative estimates of the acoustic parameters of shallow gas accu-mulation, a scheme to estimate the intrin-sic attenuation of acoustic energy (Q-factor), in presumably gasified layers, was proposed. The scheme is based on com-bined application of two quantitative and one qualitative method of different accu-racy, reliability and robustness. A simple modification of sparse-spike seismic inversion, adopted for high-resolution single-channel data, was also proposed to obtain the acoustic impedance and velo-city in presumably gasified layers. The algorithms were designed to be easy in practice, without vast consumption of computer time, to enhance the applica-bility of single-channel seismic profiling in shallow gas studies, without loosing the important advantage of its simplicity and near real-time interpretation of results.

All proposed algorithms were implement-ed using software, and their serviceability and effectiveness were tested on real data, collected within the framework of TTR in two areas of the Black Sea with different seismogeological environments. This allowed a comprehensive geological inter-pretation of the seismic data on shallow gas manifestations in all areas.



Low seismic velocity anomaly corresponding to a 'bright spot' (see (a) *above where a white box indicates the position of the model* (b) *below) observed on single-channel seismic data from the Black Sea, as detected by the inversion algorithm proposed by S. Bouriak. The velocity drop for more than 200 m/s at the interface suggests presence of free gas in the pore space of underlying sediments.*

The Ph.D. thesis was prepared under co-supervision by Prof. Dr. V.V. Kalinin (Department of Seismics and Geo-Acoustics, Geology Faculty, MSU) and Prof. Dr. M.K. Ivanov (UNESCO-MSU Centre for Marine Geosciences, Geology Faculty, MSU).

Co-operation in research and training in support of TTR

International co-operation within TTR resulted in 2000, *inter alia,* in some 40 publications with the involvement of researchers and students of the UNESCO-MSU Centre (Annex IV). Examples of joint activities are given below.

Flemish-Russian

Collaboration between MSU and Gent University started in 1997 (an agreement was officially signed on 7 February 1998) and has successfully continued. The second phase of the international co-operation project called 'Floating University' between Gent University and the Catholic University of Leuven, on one side, and MSU, on the other, has been supported by the Department of Education of the Ministry of the Flemish Community. The focus was on the preparation of a practical handbook on 'Geological and Ecological Surveying in areas of Exploitation of Natural Resources'. This handbook is fully constructed as an interactive package on CD-ROM, and the first part focuses on gas and fluids in marine sediments and related phenomena. An advanced draft has been realized (principal scientist Pavel Shashkin, MSU, working under the supervision of Prof. J.P. Henriet, Gent University), built upon data and images with the highest educational potential, collected during several TTR cruises.

The Flemish grant has also supported some further developments in MSU's data processing capacity and library.

Joint field activities have also been organized in the framework of this project. Pavel Shashkin embarked in 2000 on the R/V *Belgica* for a cruise in the Porcupine Basin, and J.P. Henriet, S. Deleu and P. Vermeesch embarked on the TTR-10 cruise (Legs 1 and 3). A field seminar on Mud Volcanism in the Kerch Peninsula (Crimea, the Ukraine) was organized by the Academy of Sciences of the Ukraine in co-operation with MSU and Gent University from 4 to 16 July 2000. Students from Belgium, Russia and the Ukraine were trained in the investigation and sampling of mud volcano sites.

Among the successes of this joint programme is the finalized and successfully defended Ph.D. dissertation by Maarten Vanneste (Gent University), in December 2000. Included in the study are results from the TTR-7 and TTR-8 cruises. Three ongoing Ph.D. studies on the Porcupine Basin, at Gent University, are partially based on TTR data (Ben De Mol, David Van Rooij and Veerle Huvenne). One M.Sc. study is being prepared at the Southampton Oceanography Centre (Veerle Huvenne); advanced processing of the TTR-7 sidescan sonar data is one of the research tasks. Four more M.Sc. studies were prepared in Gent on the Porcupine data, partially based on the TTR-7 cruise data (David Van Rooij, Sigrid Pillen, Kris Van Herreweghe and Wim Lekens).

Jean-Paul Henriet (right) in scientific discussion during a safety exercise aboard the Logachev *(TTR-10 cruise), with Serguei Bouriak*

With NIOZ

The Netherlands Institute for Sea Research, NIOZ (Dr. Tj. van Weering) was among the founder-institutions of the TTR programme. The MSU-NIOZ co-operation agreement (first established in 1990 and regularly renewed) has created opportunities for strong administrative support, provided by NIOZ, as well as collaborative research and training for MSU students. NIOZ coordinates financial inputs to TTR from the participating institutions and is responsible for field expenditures. NIOZ also reports the overall expenditures to UNESCO/IOC.

MSU researchers have participated in several workshops, organized by NIOZ, such as on gas in marine sediments — one of the priority themes that has been developed by the Institute — and have taken part in NIOZ research cruises (R/Vs *Tyro* and *Pelagia*), as well as data analyses and processing at the NIOZ laboratories.

NIOZ researchers have co-supervised a number of M.Sc. and Ph.D. projects launched at MSU and hosted the MSU students in their laboratories.

More recently, Dr. S.V. Bouriak, an MSU Centre staff scientist, visited NIOZ (17 June – 7 July 2000) where he provided consulting and software development support to this institution for enhancing their newly purchased seismic acquisition and processing system.

In 2000, two MSU under-graduate students, Alexei Sadekov and Eugeny Petrov, visited NIOZ (July to October). They participated in the R/V *Pelagia* cruise (August – September) in the Porcupine Basin and Rockall Trough after which, under the supervision of Dr. Tj. van Weering, they processed the data acquired.

A. Stadnitskaya, an MSU Ph.D. student, who has been granted a fellowship by the President of the Russian Federation, joined NIOZ in September. During the 10-month period, she is working, under the supervision of Dr Tj. van Weering, in the laboratories of the departments of Marine Chemistry and Geology, and Marine Biogeochemistry and Toxicology using materials obtained from recently discovered areas of mud volcanism and gas venting, located on the Moroccan and Spanish margins within the Gulf of Cadiz, NE Atlantic.
Until now, detailed biogeochemical investigations of mud breccia deposits in the area had not been carried out. The main objective of A. Stadnitskaya's investigation is to determine molecular and isotopic compositions of hydrocarbon gas and organic matter from mud volcanoes. She analyzes organic matter from the mud breccia matrix to identify specific biomarkers for vital bacteria activity and its relationship with focused fluid inflow, especially migrated methane. Another aspect of the organic matter study is to define probable sources of fluid and the relationship between hosting organic matter and hydrocarbon gas.

Dutch R/V Pelagia

With University Paris-VI

University Paris-VI (Dr. Jean Mascle) was among the founder-institutions of the TTR programme. In September 1991, the first UNESCO-ESF workshop was hosted by the 'Laboratoire de géodynamique sous-marine', at Villefranche-sur-mer (France). A co-operation agreement was signed later with MSU, through which a number of students and researchers have partici-pated in various joint exercises. In 2000, A. Volkonskaya, an MSU Ph.D. student, continued working with Dr. J. Mascle in processing seismic data obtained from the Mediterranean Sea. The project started in 1998 with her participation in the PRISMED-II cruise on the R/V *l'Atalante* (France), followed by a one-year training and research visit to Villefranche-sur-mer.

Elena Kozlova, a researcher, and Irina Belenkaya, a Ph.D. student from the MSU Centre, co-operated with the above University in geochemical analyses of data acquired during the TTR cruises. Excellent analytical equipment of the 'Laboratoire d`océanographie dynamique et de climatologie' (Dr. Catherine Pierre), the 'Laboratoire de Stratigraphie' (Dr. F. Baudin) and 'Laboratoire de Chimie Bio-organique et Organique Physique' ('Ecole de Chimie', CNRS, Mr. C. Largeau) was put at the disposal of TTR, in addition to supervision of the research programmes. Fruitful discussions of the results contributed to the success of the joint projects.

With Portuguese scientists

From 1998 on, researchers from the Department of Marine Geology, Institute of Geology and Minerals (Dr. Jose Monteiro), and the Department of Geosciences, University of Aveiro (Prof. Luis Pinheiro), have been actively involved in the TTR programme. Scien-tific exploration of the Portuguese continental margin, its neotectonic and depositional processes, and active mud volcanism were among the principal goals of the TTR-8, TTR-9 and TTR-10 cruises. On the proposal of Portuguese research-ers, TTR worked at the Mid-Atlantic Ridge for the first time in 2000. More than 20 scientists and students from Portugal have participated in the TTR cruises. The results were presented in a number of joint papers at post-cruise meetings and other scientific fora.

In the framework of a co-operative training programme, Anna Volkonskaya visited the Institute of Geology and Minerals, in April – May 2000, where she processed seismic data obtained during the TTR cruises on the Portuguese margin, under the supervision of Prof. Luis Pinheiro.

Russian–Portuguese co-operation took shape in a Ph.D. project started in Sep-

A group of Portuguese scientists L. Pinheiro, P. Terrinho, J. Monteiro, A. Pinto, I. Gomes Teixeira and V. Hugo (from left to right) examining samples from the Mid-Atlantic Ridge, TTR-10 cruise

tember 2000 by Vitor Hugo, devoted to studies of mud volcanism on the Portuguese margin (Gulf of Cadiz). His work is co-supervised by Prof. Mikhail Ivanov (MSU) and Prof. Luis Pinheiro (University of Aveiro). It is expected that the project will benefit from a combination of the vast MSU team experience in mud volcanism investigation and excellent knowledge of the region, as well as the adequate laboratory facilities of the Department of Geosciences, Aveiro University.

With Spanish scientists

From 1992, Spanish researchers have been actively involved in the TTR investigations. A long period of fruitful co-operation has resulted in several joint scientific publications.
The University of Granada (Prof. Menchu Comas) hosted the successful Eighth Post-cruise Conference (see next Chapter for details). The Geological Survey of Spain (Dr. Luis Somoza) has joined TTR, and took part in the TTR-10 cruise to the Gulf of Cadiz.

In 2000, A. Sautkin, an MSU Ph.D. student, who was granted a fellowship by the President of the Russian Federation, was invited for a 10-month research visit to the University of Granada.He is planning to work under the supervision of Prof. Menchu Comas with mud volcanic deposits from the newly discovered (TTR-9 cruise) mud diapiric field in the Alboran Sea.

With Southampton Oceanography Centre

The TTR Coordinator Neil Kenyon with Michael Ivanov (right)

Dr. Neil Kenyon of the above Centre provides efficient coordination to TTR, which represents the major contribution to the international success of the programme. His leading role in formulating research goals, selecting targets, data collection and interpretation, and training students within TTR is highly appreciated. In his capacity of TTR Coordinator, Neil presented the TTR results at the 33rd Session of the IOC Executive Council, in 2000 (see next Chapter for details).

As the result of an international co-operation within TTR, Andrey Akhmetzhanov, a former MSU Ph.D. student, was offered the position of research assistant in the Challenger Division for Seafloor Processes of the Centre, where he moved to in March 2000. His work is supervised by Dr. Kenyon and involves processing geophysical and geological data from deep-sea depositional systems in the North Atlantic and Mediterranean Sea. The data were collected during the TTR cruises and also include those held at the Centre. The results of this work have been submitted in a number of papers to various peer-reviewed scientific journals. Andrey was a co-chief scientist during one of the legs of the TTR-10 cruise, studying a canyon system on the north-western Irish margin.

A researcher from the SOC and one of the TTR-10 Chief Scientists, Andrey Akhmetzhanov, lecturing at a shipboard seminar

Meetings and Workshops

TTR annual conference

'Geological Processes on European Continental Margins' was the title of the Conference (31 January–3 February) organized and hosted by the University of Granada, Spain (Prof. M. Comas, Instituto Andaluz de Ciencias de la Tierra, Chairperson of the Organizing Committee). The meeting was co-sponsored by UNESCO/IOC, the Government of Andalucia and Granada University. It gathered over 40 participants from nine countries (Denmark, Italy, Morocco, Portugal, Russia, Spain, Tunisia, UK and USA). All together, 30 oral and 15 poster presentations were made.

The primary focus of the Conference was to present data and preliminary results of the TTR-9 cruise (June–July 1999), which was dedicated to investigations of slope processes, tectonics, sedimentation, fluid flow, mud diapirism and volcanism in the Northeast Atlantic and in the Western Mediterranean. The Conference also provided the opportunity to present data and results from previous TTR cruises and other research undertaken within Marine Geosciences on the European continental margins.

Sessions of the Conference included the following subjects:

1. Geological Processes on the Atlantic Margin,
2. Fluid Venting, Mud Diapirism and Volcanism,
3. Sedimentary Processes and Climate Changes in the Western Mediterranean,
4. Tectonics and Structure of the Western Mediterranean.

The first three days of the Conference were devoted to presentations of TTR results. On the fourth day, the Government of Andalusia offered a geological excursion to the Sierra Nevada National Park to the participants.

From MSU, there were thirteen students and researchers who attended the Conference, and one student came from St. Petersburg State University. They made 15 presentations at plenary sessions and three more at poster sessions.

The Conference Abstracts were published later in the year in IOC Workshop Report No. 168 (Prof. M. Comas and Dr. G. Akhmanov, editors).

Meetings of the TTR Executive Committee

TTR-EC meeting in Granada

The first year 2000 meeting of the TTR Executive Committee took place in Granada, Spain, on 31 January, on the occasion of the TTR-9 post-cruise conference. It considered the publication policy of TTR, plans for the TTR-10 cruise in summer 2000 (including proposed investigations in Latin American waters), the organization of the TTR-10 post-cruise meeting (scheduled for January-February 2001 in Moscow), as well as various TTR activities during the intersessional period.

The participants agreed to devote the cruise to studies of geological processes on the European continental margins and, for the first time, to magmatic and geothermal processes on the Mid-Atlantic Ridge south of the Azores.

Appreciation was expressed to Granada University (Prof. M. Comas) for organizing and hosting the TTR-9 post-cruise conference.

TTR-EC meeting in Paris

On 28 October, the IOC hosted the TTR-EC meeting at UNESCO, Paris. On the slate were discussions of intersessional activities (February–October) and planning of forthcoming events. Among the intersessional activities were:
(i) a successful TTR conference on 'Geological Processes on European Continental Margins' held between 31 January and 3 February in Granada, Spain;
(ii) a presentation of the TTR programme made at the IOC Executive Council (33rd Session, 20-30 June 2000);

J.P. Herniet, L. Pinheiro and P. Bernal (from left to right) at the TTR-EC meeting in Paris

(iii) TTR-10 cruise, conducted very successfully in the North Atlantic, in July and August, with participants from three continents (Africa, Eurasia and Latin America);
(iv) two documents issued: IOC Workshop Report No.168 and the Floating University Annual Report 1999;
(v) a number of bilateral projects carried out under the TTR umbrella, examples were: the Flemish-Russian 'Floating University' project, funded by the Flemish Government, as well as several short-term and long-term research and training exchanges (among Belgium, France, the Netherlands, Portugal, Russia and the UK) of TTR researchers and students.

Planned activities included:
(i) the TTR-10 post-cruise meeting and international conference 'Geological Processes on Deep-Water European Margins' (Moscow, Russia, 28 January–3 February 2001), and
(ii) the TTR-11 geological-geophysical cruise.

At the meeting, Dr. Patricio Bernal, Assistant Director-General of UNESCO and IOC Executive Secretary, indicated his appreciation of this marine geoscience project, 'the only in the world' based on students' training combined with advanced research, producing excellent scientific results. Following the TTR success, the IOC has received a number of requests to launch similar projects in Africa, the Caspian Sea and other regions. According to P. Bernal, TTR should provide guidance to similar initiatives in other regions, to get them off the ground. Finally, Dr. Bernal ensured that IOC support to TTR would continue and referred to IOC Resolution EC-XXXIII.15 (2000) (Annex V).

Significant added value of TTR to European programmes was stressed, as well as the fact that TTR has triggered some of the European programmes.

At the same time, more dissemination of the research results and information is required, including publicity campaigns (like showing spectacular underwater records to potential donors and the general public).

Detailing the situation with the proposed cruise to Latin America, A. Suzyumov informed the meeting about letter dated 18 October 2000 from Dr. Paulo Rogerio Gonzales, Ministry of Science and Technology of Brazil. Dr. Gonzales expressed his appreciation of TTR based on reports from the participants to the TTR-10 cruise. He refers to the 'high scientific quality of both the equipment and research developed on board the *Logachev*, the recognized 'importance of the TTR programme' and 'outstanding quality of its research'. He also stated the 'impossibility of committing funds in 2001'. However, the Brazilian counterparts envisaged 'a number of possible concrete actions to be pursued for TTR in 2002'. Thus, previously discussed plans of surveying the Brazilian continental margin within the framework of TTR-11 were postponed to the year 2002.

Sample of other meetings attended by the MSU researchers and students

CIESM Workshop on African continental margins of the Mediterranean Sea (22-25 November, Tunisia), chaired by Dr. J. Mascle (President of the CIESM Committee on Marine Geosciences) and Dr. F. Briand (Director General, CIESM), brought together 15 scientists from 8 countries (Algeria, France, Germany, Monaco, Morocco, Russia, Tunisia and the UK). Among the Workshop goals were: (i) a general assessment of current knowledge on the structure and evolution of the continental margins of North Africa; and (ii) future research needs in the area. During the first few days, the participants made presentations, followed by intensive

discussions on tectonics, sedimentation and the geological history of the North African passive margin in the Eastern Mediterranean and activated Maghreb margins. The last two days were devoted to discussion of conflicting concepts and hypotheses in an interactive round table format, and drafting the executive summary.

A contribution from TTR was made by Dr. N. Kenyon (SOC), who gave a talk on 'Channelised deep-sea depositional system in the Mediterranean', and by a researcher from the Centre, Dr. G.G. Akhmanov with a talk on the 'Evolution of sedimentation patterns on North African margins: an update from studies of recent mud volcanic deposits'. This work was done in co-authorship with Prof. M.K. Ivanov, Dr. J.M. Woodside, Prof. M.B. Cita, and Dr. N.H. Kenyon, based on data collected during several TTR cruises in the Mediterranean Sea.

VI International conference on gas in marine sediments was held in Repino (St. Petersburg) 5-9 September 2000. The conference was organized by VNIIOkeanologiya institute (St. Petersburg) in co-operation with the Shallow Gas Group. The topics presented on the conference covered geosciences, biosciences, marine sciences and other topics related to gas in sediments. S. Bouriak, a researcher from the Centre, presented data obtained during TTR-10 expedition on bottom simulating reflectors below the Storega Slide deposits and at the southern edge of the Vøring Plateau. A. Stadnitskaya and I. Belenkaya, both Ph.D. students of the Centre, presented other two papers, devoted to hydrocarbon gas composition in mud volcanic areas of the Gulf of Cadiz and to morphology, mineralogy, chemistry and isotopes of gas-derived carbonates.

Annex I

LIST OF INSTITUTIONS WHICH COOPERATED IN THE EXECUTION OF THE TTR PROGRAMME in 2000

Belgium
University of Gent, Gent
University of Leuven, Leuven

Brazil
PETROBRAS Co., Rio de Janeiro

France
University Paris-VI:
  Laboratoire de géodynamique sous-marine, Villefranche-sur-mer
  Laboratoire d'océanographie dynamique et de climatologie, Paris
  Laboratoire Stratigraphie, Paris
Laboratoire de Chimie Bioorganique et Organique Physique (Ecole de Chimie, CNRS), Paris

Georgia
Tbilisi State University, Tbilisi

Italy
University of Genoa, Genoa
Institute for Marine Geology, Bologna
University of Milan, Milan

Morocco
Mohammed V University, Rabat

The Netherlands
The Netherlands Institute for Sea Research, Texel

Portugal
Instituto de Geologico e Mineiro, Lisbon
University of Lisbon, Lisbon
University of Aveiro, Aveiro
Abel Salasar Institute of biomeducal sciences, Oporto

Russia
Ministry of Natural Resources
Ministry of Industry, Science and Technology
Moscow State University
Polar Marine Geophysical Expedition, St. Petersburg
St. Petersburg State University, St. Petersburg
VNIIOkeangeologiya Co., St. Petersburg
NIPIOkeangeofizika, Gelendzhik

Spain
Geological Survey of Spain, Madrid

Switzerland
Commission for Oceanography and Limnology, Geneva

The Ukraine
Ukrainian Academy of Sciences, Kiev

United Kingdom
Southampton Oceanography Centre, Southampton
GEOTEK Co., Southampton
University of Aberdeen, Aberdeen

Annex II

LIST OF PARTICIPANTS

TTR-10 Cruise,
R/V *Professor Logachev*
13 July – 28 August 2000

Belgium
Gent University:
Jean-Pierre Henriet
Peggy Vermeersch
Samuel Deleu

Brazil
Petrobras Co.:
Waldemar de Almeida
Dennis James Miller

Georgia
Tbilisi State University:
Zurab Savaneli

Italy
University of Genoa:
Adriano Mazzini
Inst. for Marine Geology,Bologna:
Marzia Rovere

Morocco
Mohammed V University, Rabat:
Naima Hamoumi

Portugal
Aveiro University:
Luis Pinheiro (Leg 1 Co-Chief Scientist)
Marina da Cunha
Instituto de Geologico e Mineiro, Lisbon:
Jose Monteiro (Leg 2 Co-Chief Scientist)
Francisco Teixeira
Manuel Quartau
Pedro Terrinha
Vitor Hugo
Tiago Cunha
Cristina Dias Lopes
Pedro Ferreira
Emilia Salgueiro
Alvaro Pinto
University of Lisbon:
Luis Matias
Instituto de Ciences Biomedicas Abel Salazar:
Anna Hilario
Isabel Gomes Teixeira

Russia
Alexander Arutyunov (captain, R/V *Professor Logachev*)
Technical Support Staff, Polar Expedition:
Mikhail Maslov (Chief Shipboard Scientist)
Alexandr Ashadze
Alexandr Machulin
Evgeny Samsonov
Igor Tyunyakin
Gennady Antipov
Irina Antipova
Victor Sheremet
Victor Tsybulsky
Valentin Konfetkin
Anatoly Shagin
Alexandr Shagin
Alexandr Plakhotnik
Sergey Luybimov
Konstantin Plakhotnik
Vyacheslav Gladush
Vladimir Kyasper
Alexandr Nescheretov
Vladislav Malin
Vladimir Zakharychev
MSU researchers and students:
Michael Ivanov (Co-Chief Scientist)
Elena Kozlova
Sergey Buryak
Pavel Shashkin
Anna Volkonskaya
Grigorii Akhmanov
Alina Stadnitskaya
Irina Belenkaya
Alexander Sautkin
Sergey Shkarinov
Ivan Denisenko
Igor Kuvaev
Vasily Galaktionov
Dmitry Ovsyannikov
Valentina Blinova
Alexey Stepanov
Ivan Pasechnik
Ksenia Ivanova
Nikolay Galin

VNIIOkeangeologiya:
Leonid Mazurenko

Spain
Geological Survey of Spain:
Luis Somoza

Switzerland
Institute of Geology, University of Neuchatel:
Pierre-Michel Brudder
Gaelle Dupont

U.K.
Southampton Oceanography Centre:
Andrey Akhmetjanov
(Leg 3 Co-Chief Scientist)
Bramley Murton
Najeeb Rasul
Juliette Biggs
Ana Paula Teles
Arnaud Mille
Paul Barnett
GEOTEK Co.:
Robert Swift
University of Aberdeen:
Bryan Cronin

Annex III

LIST OF SEMINAR PRESENTATIONS

TTR-10 Cruise,
RV *Professor Logachev*
13 July – 28 August 2000

14 July	General meeting of the Leg-1 participants
15 July	Luis Pinheiro (Portugal). The main targets of Leg-1
16 July	Pedro Terrinha (Portugal). Seismogenic structures offshore SW Potrugal
17 July	Luis Matias (Portugal). The deep structure of continental margins studied from wide-angle data
18 July	Naima Hamoumi (Morocco). The state of knowledge of the Morroccan Atlantic Shelf
19 July	Jean-Pierre Henriet (Belgium). Fluid flow and mounds in the Porcupine Basin
20 July	Luis Somoza (Spain). Tectonic and Sedimentary Processes in the Gulf of Cadiz
21 July	Dmitry Ovsjannikov (Russia). Rock clasts lithology from mud breccia of the Gulf of Cadiz
23 July	Discussion: preliminary results of Leg-1
26 July	General meeting of the Leg-2 participants
27 July	Alina Stadnitskaya (Russia). Hydrocarbon gas distribution in mud volcanic deposits of the Gulf of Cadiz
28 July	Irina Belenkaya (Russia). Authigenic carbonates as a product fueled by hydrocarbons at submarine cold seeps
29 July	Leonid Mazurenko (Russia). Gas Hydrates of the Gulf of Cadiz Mud Volcanoes: Results of Hydrogeochemical Investigations
30 July	Alexandr Ashadze (Russia). Overview of methods and main results at complex investigations performed by PMGE in the axial zone of the Mid-Atlantic Ridge (between 11-30°N)
31 July	Discussion: preliminary results of Leg-1 and plans for Leg-2
1 August	Bram Murton (UK). Hot rocks; oasis in the abyss or Heat, chemical and biological fluxes from a segment of the Mid Atlantic Ridge
2 August	Pedro Ferreira (Portugal). Acquisition of analytical data in silicate rocks: a world of uncertainty
3 August	Alvaro Pinto (Portugal). The Neves Corvo VMS ore deposit – textural evidences of the metalogenic processes
4 August	Najeeb Rasul (UK). From Mountain High to Ocean Deep: provenance, composition and transport pathways – an example from the Arabian Sea, NW Indian Ocean
5 August	Waldemar de Almeida Jr. (Brazil). Seismic Features about a Modern Turbidites System of the Basin Campos of Brazil
6 August	Discussion: preliminary results of Leg-2
10 August	Andrey Akhmetjanov (UK). Leg-3 TTR-10 tasks on the North Eastern European Margin

11 August	Sergey Bouriak (Russia). Technology of seismic data acquisition
12 August	Sergey Shkarinov, Vasily Galaktionov and Igor Kuvaev (Russia). Onboard acoustic equipment. How it works?
13 August	Grigorii Akhmanov, Valentina Blinova, Alexey Stepanov, Ivan Pasechnik (Russia). Bottom Sampling: Strategy, tools and technics (Why, How and What). Part 1
14 August	Nikolay Galin, Irina Belenkaja (Russia). Bottom Sampling: Strategy, Tools and Technics (Why, How and What). Part 2
15 August	Bryan Cronin (UK). Slumping, channels and mass-wasting on the Irish Margin: Why are we here, what have we seen, what next?
16 August	Dennis James Miller (Brazil). Applied Marine Geology in the Campos Basin, SE Brazil
18 August	Ana Paula Teles (UK). Tide Propagation along the Solent Channel, Southern England
19 August	Paul Barnett (UK). The use of the TV Grab in the acquisition of biological data for the compilation of an Environmental Impact Assessment
20 August	Andrey Akhmetzhanov (UK). Evidence of strong deep-sea bottom currents on the NE European Atlantic Margin
22 August	1st Seminar on Processes on the Irish Margin
23 August	Sergey Bouriak (Russia). Inferred Gas Hydrates and Clay Diapirs Near the Storegga Slide on the Southern Edge of the Voring Plateau, Offshore Norway: What we do know and what we do want to know
24 August	2nd Seminar on Processes on the Irish Margin
25 August	Elena Kozlova (Russia). Organic matter in the rock clasts of the mud volcanic breccia (examples from the Gulf of Cadiz, Mediterranean and Black Seas)
27 August	Discussion: preliminary results of Leg-3

Annex IV

LIST OF PUBLICATIONS BY RESEARCHERS AND STUDENTS OF THE UNESCO-MSU CENTRE, year 2000

Akhmanov, G., Limonov, A., Ivanov, M., Cita, M.B., Premoli, I., Erba, E. The Cretaceous-Neogene sedimentary history of the Eastern Mediterranean: an update from study of recent mud volcanic deposits. – In: Geological Processes on European Continental Margins. TTR-9 Post-Cruise Conference. Abstracts, University of Granada, Granada, Spain. pp. 8-9, 2000.

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Akhmetzhanov, A.M., Kenyon, N.H., Ivanov, M.K., and Cronin, B.T. The continental rise west of Porcupine Seabight, northeast Atlantic. European margin sediment dynamics. Atlas of side-scan sonar and seismic images. *(Submitted*).

Akhmetzhanov, A.M., Kenyon, N.H., Ivanov, M.K., Wheeler, A.J., Shashkin, P., and van Weering, T.C.E. Giant carbonate mounds and current swept seafloors on the slopes of the southern Rockall Trough. European margin sediment dynamics. Atlas of side-scan sonar and seismic images. *(Submitted*).

Belenkaya, I., Goncharov, D. Gas-related changes in the pore water chemical composition: application to the authigenic carbonates formation (TTR-9, Gulf of Cadiz). – In: Geological Processes on European Continental Margins. TTR-9 Post-Cruise Conference. Abstracts, University of Granada, Granada, Spain. p.13, 2000.

Belenkaya, I. Gas-derived carbonates: revews in morphology, mineralogy, chemistry and isotopes (data collected during the TTR Programme cruises during 1995-1999.- In Gas in Marine sediments -VI International Conference. Abstracts, St.-Petersburg, Russia, 5-9 September, 2000

Bobrov, A. The bottom of Upper Messinian evaporites observed within the diapirs in the South Balearic Basin, according to seismic data. – In: Geological Processes on European Continental Margins. TTR-9 Post-Cruise Conference. Abstracts, University of Granada, Granada, Spain. p. 14, 2000.

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Bouriak, S., Ivanov, M., Akhmetzhanov, A., and Shipboard Scientific Party of TTR10 Cruise, Leg 3. Bottom simulating reflectors below the Storega Slide deposits and at the southern edge of the Vøring Plateau: new data from TTR-10 Cruise of R/V Professor Logachev, August 2000.- In: Gas in Marine sediments VI International Conference. Abstracts, St.-Petersburg, Russia, 5-9 September 2000.

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Cronin, B.T., Hurst, A., Akhmanov, G., Spadini, G. and Rocchini, P. 2000. Predicting deep-water turbidite reservoir quality and geometry: deepwater examples off West Africa, Rockall. *Offshore Magazine (International Edition),* Vol. 60, Number 11, pp. 98-101.

De Mol, B., Vanreusel, A., Henriet, J.-P., Swennen, R., Ivanov, M., Crocker, P. Deep Coral banks in Porcupine Basin (South west of Ireland, North East Atlantic). – In: First International Symposium on Deep Sea Corals, Science and Conservation of Deep Sea Corals, 30 July – 2 August 2000. Halifax, Nova Scotia, Canada. *(Submitted).*

Grachev, A. Processing of multi-channel seismic data collected on the Portuguese Margin during TTR-9 cruise.– In: Geological Processes on European Continental Margins. TTR-9 Post-Cruise Conference. Abstracts, University of Granada, Granada, Spain. p. 20, 2000.

Ivanov, M., Kenyon, N., Nielsen, T., Wheller, A., Monteiro, J., Gardner, J., Comas, M., Akhmanov, G., Akhmetjanov, A., and Scientific Party of the TTR-9 cruise. Goals and principles of the TTR-9 cruise. – In: Geological Processes on European Continental Margins. TTR-9 Post-Cruise Conference. Abstracts, University of Granada, Granada, Spain. p. 24, 2000.

Ivanov, M., Pinheiro, L., Henriet, J., Gardner, J., Akhmanov, G. 2000. Some Evidences of the Ralationship Between Carbonate Mound Formation and Cold Seepage in the Gulf of Cadiz.-in 2000 Fall Meeting AGU, San-Francisco, December, 2000

Kenyon, N.H., Akhmetzhanov, A.M., Nielsen, T., Kuijpers, A., Ivanov, M.K., and Shashkin, P. Sandy contourites and pathways of the Norwegian Sea overflow water, west of the Faeroe Bank Channel. European margin sediment dynamics. Atlas of side-scan sonar and seismic images. *(Submitted*).

Kenyon, N.H., Akhmetzhanov, A.M., Twichell, D.C. Sand wave fields beneath the loop current, Gulf of Mexico: reworking of fan sands. Marine Geology. *(Submitted).*

Kenyon, N., Ivanov, M., Akhmetzhanov, A., Akhmanov, G. (Eds) Multidisciplinary Study of Geological Processes on the North East Atlantic and Western Mediterranean Margins. *IOC Technical Series* No. 56, UNESCO, 2000, 102 pp.

Kozlova, E., Gardner, J., Baudin, F., Largeau, C. Geochemical investigation of organic matter in rock clasts from mud volcano breccia (Gulf of Cadiz and Alboran Sea). – In: Geological Processes on European Continental Margins. TTR-9 Post-Cruise Conference. Abstracts, University of Granada, Granada, Spain. p. 28, 2000.

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Ovsyannikov, D., Sadekov, A. Rock clasts lithology of mud volcano breccia from the Gulf of Cadiz. – In: Geological Processes on European Continental Margins. TTR-9 Post-Cruise Conference. Abstracts, University of Granada, Granada, Spain. p. 33, 2000.

Petrov, E. Inferred shallow gas accumulations on the Moroccan continental Margin (Gulf of Cadiz) according to the geophysical data of TTR-9 cruise. – In: Geological Processes on European Continental Margins. TTR-9 Post-Cruise Conference. Abstracts, University of Granada, Granada, Spain. p. 35, 2000.

Sadekov, A., Ovsyannikov, D. Age of rock clasts from Yuma mud volcano breccia on the basis of foraminifera study (Gulf of Cadiz, NE Atlantic). – In: Geological Processes on European Continental Margins. TTR-9 Post-Cruise Conference. Abstracts, University of Granada, Granada, Spain. p. 39, 2000.

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Stadnitskaya, A., Ivanov, M., Gardner, J. Hydrocarbon gas composition and distribution in surface sediments of mud volcanic province. Gulf of Cadiz, NE Atlantic.-In: Gas in Marine sediments-VI International Conference. Abstracts, St.-Petersburg, Russia, 5-9 September 2000.

Suslova, E. Physical properties of rock clasts from the mud breccia of the Yuma mud volcano (the Gulf of Cadiz). – In: Geological Processes on European Continental Margins. TTR-9 Post-Cruise Conference. Abstracts, University of Granada, Granada, Spain. p. 47, 2000.

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Козлова Е.В.. Баженова О.К., Иванов М.К., Боден Ф. Органическое вещество в обломках пород из грязевулканической брекчии (залив Кадис, Северная Атлан-тика)/Тезисы конференции «Ломоносовские чтения» 24-27 апреля 2000., г. Москва, изд-во МГУ, с. 31-33.

Овсянников Д. О. Верхнеальбские отложения юго-западного Крыма: литострати-графия.- // Геология Чёрного и Азовского морей. Киев. 2000. с. 89-93.

Овсянников Д.О., Садеков А.Ю. Литология грязевулканической брекчии залива Кадис (Северо-Восточная Атлантика). // Материалы Международной конференции студентов и аспирантов по фундаментальным наукам “Ломоносов –2000”. Вып. 4. с.194-195. 2000

Садеков А.Ю., Овсянников Д.О. Возраст обломков из брекчии грязевого вулкана Юма (Залив Кадис, СВ Атлантика) по данным изучения фораминифер. // Материалы Международной конференции студентов и аспирантов по фундаментальным наукам “Ломоносов –2000”. Вып. 4. с.197-198.

Annex V

Resolution EC-XXXIII.15[1]

TRAINING-THROUGH-RESEARCH CONCEPT AND THE FLOATING UNIVERSITY PROJECT

The Executive Council,

Being informed about the essential components of the Training-through-Research concept within the Floating University Project; its operations in the North Atlantic, Mediterranean, Black, and Baltic Seas; its cooperation, networking, planning, participation, data analysis and prolific scientific publication record, involving multinational universities, research institutions and industry,

Recalling Resolution XVIII-14, by which IOC decided to co-sponsor the Project through TEMA and to provide a limited financial contribution to its key activities of planning, student participation and publication,

Noting with satisfaction that:

(i) the innovative and internationally recognized success of the Training-through-Research concept, complementing shore-based and traditional shipboard training, has been fully realized within the Floating University Project, and represents the basis for its advanced research results,

(ii) the Project contributes to intercultural exchange and is developing to include partners from regions other than the initial regions of eastern and western Europe,

Recognizing that the execution of the Project would not be possible without substantial financial support from the Member States, which comes through bilateral cooperation agreements and from a number of national and European science projects, as well as from donors in offshore industry with direct interests in its research results,

Calling attention to the necessity for quick and adequate sharing and transfer of knowledge among the Member States, and for further developing and supporting the existing advanced teaching and training methods, and new forms of "training-through-research" in the field of marine sciences,
Expresses its appreciation to the Member States for the support provided to the Project;

Urges Member States to maintain and expand this support in the future;

Notes the intent of Resolution XX-19 to emulate and extend the concept by establishing a Caspian Sea Floating University;

Invites Member States to put forward proposals, accompanied by an outline of the available facilities and co-funding, leading to the establishment of "Floating Universities" in other regions.

Financial implications to the IOC: US$20,000 annually from Regular Programme

[1]Intergovernmental Oceanographic Commission (of UNESCO). Thirty-third Session of the Executive Council. Paris, 20-30 June 2000. Adopted Resolutions. IOC/EC-XXXIII/3 prov. Annex II

Annex VI

LIST OF ACRONYMS

BSR	Bottom simulating reflector
CIESM	International Commission for the Scientific Exploration of the Mediterranean Sea
CNRS	National Centre for Scientific Research (France)
CTD	Conductivity-Temperature-Depth probe
ESF	European Science Foundation
IOC	Intergovernmental Oceanographic Commission
MSU	Moscow State University
NIOZ	Netherlands Institute for Sea Research
ODP	Ocean Drilling Program
OKEAN	long-range sidescan sonar system
O.R.E.tech	deep towed sidescan sonar system
RAS	Russian Academy of Science
R/V	Research Vessel
SOC	Southampton Oceanography Centre
SOZ	The Netherlands Marine Research Foundation
TEMA	Training, Education and Mutual Assistance (programme of IOC)
TREDMAR	Training and Education in Marine Sciences
TTR	Training-through-Research
UNESCO	United Nations Educational, Scientific and Cultural Organization