Marine science: Joining forces for the environment

At the international level, inter-agency initiatives involving scientists worldwide are targetting environmental threats to our oceans and seas

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More than 70 percent of the earth's surface is covered with water — and fully 97% of that water is contained in saline seas. Marine ecosystems are vital to global food supplies: roughly one billion people, most of them in developing countries, depend on fish for their sole source of protein. And more than half the people on earth live in coastal zones.

The importance of the oceans and seas to economic well-being and environmental balance is acknowledged. But in a rapidly industrializing world with a population of roughly 6 billion people, what is being done to preserve this unique resource for generations to come?

For most of its 40 years, the IAEA has supported the only marine laboratory in the United Nations system, the Marine Environment Laboratory (MEL) in Monaco. Today, MEL is among the foremost specialized marine science establishments in the world, at the forefront of international efforts to understand, preserve, and protect the marine environment. In addition to the Government of Monaco, principal funders of MEL are the IAEA and United Nations Environment Programme (UNEP). Partners in research and field activities include the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO), Japan, Sweden, Germany, France, the European Commission, and a number of other governments and non-governmental organizations.

Over the past decade, MEL's expertise has been applied to many pressing international environmental challenges:

- Tracking the effects of ocean disposal of nuclear wastes;
- Assessing and mitigating the marine impacts of the Gulf War;
- Investigating the radiological consequences of nuclear weapons testing in the Pacific;
- Analyzing the "greenhouse effect" and the potential for "global warming;" and
- Studying the impacts of industrial and agrochemical pollution on marine ecosystems. *(See box, page 11.)*

This article offers a global perspective on inter-agency co-operation concerning pollution of the marine environment. Included are overviews of the MEL's work, and highlights of specific activities related to environmental assessment of the Black Sea, pesticides in the marine environment, and the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities.

Special environmental initiatives

Working with a range of partners, MEL is playing a key role in a number of special international scientific investigations related to marine radioactivity and ecosystems:

Nuclear wastes in Arctic Seas. Together with experts from Russia, Norway, and USA, MEL has been undertaking five expeditions to and laboratory analysis of samples collected in the Kara and Barents Seas to determine potential hazards to humans and the marine environment from dumped wastes, including reactors. Computer models have also been developed to predict the dispersion of any future leakage, and laboratory studies of concentration factors and distribution coefficients in Arctic conditions

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IAEA's Marine Environment Laboratory in Monaco: Yesterday and today

A strong commitment to guarding the integrity of the seas comes naturally for the people of Monaco, given the Principality's location and economic reliance on the Mediterranean. But it was with considerable foresight that, back in 1959, Prince Rainier III hosted the first world-wide scientific conference on the disposal of radioactive wastes on land and at sea. Two years later, Monaco's government and the IAEA formalized their partnership by establishing MEL's predecessor, the International Laboratory of Marine Radioactivity, dedicated to improving knowledge about the behaviour of radionuclides in the seas and promoting use of nuclear and isotopic techniques in protecting the marine environment. With the continuing support of the IAEA and the Principality, the Laboratory expanded the scope of scientific research and field activities over the decades into many related fields and established itself as a valuable source of technical assistance for IAEA Member States. In 1991, it was renamed the "Marine Environment Laboratory" to convey more accurately the broad scope of responsibilities it had assumed in providing scientific expertise and technical support internationally. Today MEL operates on a modest regular annual budget of about US $5 million and has a full time staff of about 50 scientists, technicians and administrative personnel. Extrabudgetary resources for specialized research and services from a variety of governments and international bodies total some US $3 million annually. MEL activities concentrate on five principal areas:

- Understanding marine radioactivity;
- Improving knowledge about oceans using isotopic techniques
- Training staff and extending capabilities of IAEA Member States;
- Providing analytical quality control services;
- Promoting inter-agency efforts to protect the seas.

At left: SAS Prince Rainier III and Dr. Blix in January 1996. *(Gaetan LUCI)*

have been carried out. *(See the article beginning on page 21.)*

Nuclear weapons tests in the South Pacific. At the request of the French Government, MEL is participating in an in-depth analysis of the radiological consequences of several decades of weapons testing on the Mururoa and Fangataufa Atolls in French Polynesia. The study is being directed by a special International Advisory Committee convened by IAEA's Director General, and will assess not only the current radiological situation but also the long-term ecological impacts.

Rising waters of the Caspian Sea. In collaboration with the IAEA's Isotope Hydrology Section at the Agency's headquarters in Vienna, the UNEP, and governments from the affected zones, MEL is conducting studies to understand better the causes of the dramatically rising levels of the Caspian Sea. By employing isotopic techniques to study the water cycle, the investigation will provide a new platform for the affected countries to co-operate in solving this environmental challenge.

Pollution of the Black Sea. In collaboration with UNDP and the IAEA's own Department of Technical Co-operation, MEL is at the centre of a combined research and capacity building initiative that addresses the rapidly deteriorating condition of Black Sea waters. Isotope tracers are being used to investigate water circulation and pollutant behaviour. Equipment and training activities also are being provided to ensure an improved regional ability to monitor and control the quality of the marine environment. *(See box, page 13.)*

Promoting inter-agency initiatives to protect the seas

The importance of global actions to protect the seas was stressed in Agenda 21, the document adopted at the UN Conference on Environment and Development in 1992. Chapter 17 of Agenda 21 calls for "new approaches to marine and coastal area management and development at the national, sub-regional, regional and global levels" and the strengthening of inter-agency co-operation in this regard. Emphasis was also placed on building the capacities of national and regional institutions (especially in developing countries) for making environmental assessments and controlling marine pollution.

Pesticides in the marine environment

Agrochemicals, and in particular pesticides, have become an integral part of modern agriculture systems contributing significantly to improved crop yields and enhanced production of food. Nevertheless, the lack of specificity of some pesticides, their persistence in the environment and their irresponsible use in certain regions have produced undesirable side effects. Besides the direct exposure of humans, pesticide residues introduced in aquatic ecosystems have been reported to cause massive fish and shrimp kills, to reduce the reproductive success of species and to contribute to the death of coral reefs so that ultimately they may have a major impact on fishery resources, biological diversity and the functional equilibrium of ecosystems.

An assessment of the ecological risk posed by pesticide residues in marine ecosystems is, for the most part, yet to be undertaken. Environmental risk assessment and introduction of measures to manage or counteract the risk of pesticide residues require expanded knowledge of the environmental behaviour and effects of pesticides. To this end, enhanced laboratory capacities in the countries are needed in order to implement ample marine monitoring programmes. Furthermore, experimental research is also required to generate the necessary data on the cycling, fate and effects of pesticides in marine ecosystems.

In the study of the environmental fate of pesticides, the use of carbon-14 labelled molecules has for some years provided an invaluable tool for research in both terrestrial and aquatic environments. They allow a compound to be followed in experimental systems and for the unambiguous identification and quantification of transformation products at very low concentrations. Because only the radioactive carbon is measured, for many purposes sample clean-up is less rigorous than that required by other techniques such as chromatography. Consequently, a large number of samples can be processed rapidly and measured with standard liquid scintillation equipment at low cost.

To develop relevant studies, MEL organized a coordinated research programme on the Distribution, Fate and Effects of Pesticides in Biota in the Tropical Environment, with support provided by Sweden. The programme currently includes participants from 17 Member States in Asia, Africa and America where pesticide research exists or is being developed. The results should be instrumental in expanding the present knowledge of environmental contamination by pesticide residues in tropical coastal regions and in the assessment of the potential consequences.

Recommendations for improving the management of the sensitive ecosystems of tropical coastal areas will be formulated to help Member States implement practical measures to harmonize the interests of agriculture with the preservation of their aquatic resources. The other specialized agencies of the UN family operate other programmes in this area. For example, the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities which aims, namely, to assess the severity and impact of persistent organic pollutants. The IAEA's project is complementary and illustrates how nuclear techniques can uniquely fill existing gaps in knowledge and methodology.

The IAEA and other organizations are leading efforts to strengthen the capabilities of laboratories to analyze biological samples as part of marine monitoring programmes. ***(IAEA-MEL)***

Thus, in addition to carrying out an IAEA-focused work programme, MEL responds regularly to requests for technical assistance from many other United Nations agencies, international organizations, and governments. Within the UN, co-operative activities are formally established with UNEP and IOC-UNESCO. There is also extensive collaboration with the World Meteorological Organization, the World Health Organization, the World Bank, the UNDP, the UN Food and Agriculture Organization, and the International Union for the Conservation of Nature in programmes of assistance for developing countries.

A focal point for this co-operation is being provided by the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities, which has been requested and supported by Member States and requires MEL's services for analytical capacity building. *(See box, pages 14-15.)*

Understanding marine radioactivity

Since its beginnings, MEL has been engaged in deepening scientific understanding of marine radioactivity. Over the decades, moreover, research has broadened to include analysis of a wide range of non-radioactive pollutants in the marine environment, using nuclear and isotopic techniques.

MEL scientists examine the consequences of radioactive discharges and disposals by monitoring and assessing radionuclide levels and modelling their dispersion in the marine environment. The results then assist Member States in radiological assessments related to nuclear weapons test sites, nuclear waste disposal areas, and in emergency responses to accidents at sea. To facilitate this work, MEL has created a Global Marine Radioactivity Database (GLOMARD) to provide countries with radioactivity baseline data on seawater, sediment, and biota for undertaking assessments. In addition, a large-scale project on Worldwide Marine Radioactivity, supported by Japan, is being carried out with the aim of providing new data on present radionuclide levels in the oceans and seas.

Improving knowledge of oceans

Nuclear and isotopic techniques are being employed in a wide variety of research activities aimed at enhancing understanding and improving the management of marine ecosystems:

- Establishing the distributions of natural radionuclides in marine ecosystems and the resulting doses to humans through the food chain;
- Tracing the behaviour and fate of key radionuclides and natural analogue elements;
- Measuring the rates and ages of marine samples and processes using the unique timeclock of radioactive decay; and;
- Mapping the biological processes leading to the aggregation of particulate carbon.

As mentioned above, radiotracer methods are used to study agrochemical compounds, such as pesticides, and their accumulation and effects in marine systems. They are also used in establishing the pathways and accumulations of heavy metals and other toxic elements in the marine environment and their effects on people and ecosystems.

Training and capacity building

In co-operation with the IAEA Departments of Research and Isotopes and Technical Co-operation, MEL provides support to developing countries in obtaining high quality data on marine radioactivity and radioecology, while the non-nuclear contaminants are covered through close co-operation with other specialized agencies including UNEP, the IOC-UNESCO and the United Nations Development Programme (UNDP). The Laboratory also supports marine pollution monitoring and research in developing countries by conducting joint exercises and training courses as part of an integrated programme of quality assurance.

Each year approximately a dozen specialist training courses are conducted for participants from developing countries in subjects such as marine radioactivity and radioecology, radiochemistry, and various aspects of analytical chemistry. MEL also sponsors dozens of trainees from developing countries to work on research projects at Monaco and elsewhere to enhance their scientific skills. During 1996, MEL implemented 10 IAEA Technical Co-operation Projects, while providing advisory and technical assistance missions to 31 countries.

Providing analytical services

In order to produce reliable scientific results, monitoring laboratories need to follow a quality control system that includes regular

Environmental protection of the Black Sea: Assessing the picture

Late last year, the Global Environment Facility (GEF) Black Sea Environmental Programme (BSEP) offered an informative perspective on inter-agency efforts to protect the Sea from environmental pollution. An excerpt from the report, published in the September 1996 edition of the GEF newsletter *Saving the Black Sea*, follows:

A deadly soup? *"Three years ago a leading international newspaper described the Black Sea as a "Deadly Soup of Toxic Waste". At that time, there was little or no reliable information available to confirm or deny such an alarming statement. The sea certainly looked visibly dirty, judging by the green-brown colour of the water and the litter on the beaches, many of which were closed to tourists. The Black Sea ecosystem was also in a catastrophic state of decline. All of these visible signs, together with the knowledge that much of the waste of 17 countries drains to the Black Sea, could easily lead to a sense of hopelessness.*

"Science, however, does not depend upon anecdotes but seeks out hard facts. Much of the limited data available had not been obtained using the well-proven techniques and independent quality control procedures which are now demanded of those working in the marine environment. One of the key roles of the new Black Sea Environmental Programme (BSEP) with collaboration of its partners (IAEA, IOC, UNEP, EU) was thus to provide the missing equipment, techniques and quality control in order to obtain a better evaluation of the realities of the Black Sea pollution. Inevitably, despite the presence of excellent scientists already working in the region, it takes time and money to upgrade scientific institutions, and the process is far from complete. In view of the urgent need for reliable data, institutions in the Black Sea, western Europe and the U.S., and several UN Agencies decided to cooperate to undertake a series of pilot studies in representative areas of the sea. The areas studied included the continental shelf of Ukraine (the Activity Centre for Special Pollution Monitoring, Odessa, together with the IAEA Marine Environmental Studies Laboratory — MESL — in Monaco), the shelf off the entrance to the Bosphorus, (Middle East Technical University, Erdemli, with MESL), the coastal area near Sochi, Russia (the Hydromet Centre, Sochi, with MESL) and the north-western Black Sea shelf and Danube discharge. The result was the preparation of the first ever comprehensive pollution review, entitled "The State of Pollution of the Black Sea", which will be shortly published."

Following a comprehensive scientific assessment of the problems facing the Black Sea, on 31 October 1996, in Istanbul, the governments of the six Black Sea countries approved a Strategic Action Plan for the Rehabilitation and Protection of the Black Sea.

What will happen next? The Black Sea regional monitoring system is expected to be underway in 1997. It will include strong provisions for "biological effects" monitoring and an independent quality control system for much needed high quality analytical data on marine contaminants. More scientific research is also still required. Moreover, capacity building in laboratories of the region, training in analytical techniques and data quality assurance on marine contaminants continue to be a top priority for the IAEA and inter-agency support to the Black Sea countries.

IAEA programmes. The IAEA is supporting efforts in the Black Sea region through programmes related to both radioactive and non-radioactive pollutants. MEL's role is to provide technical and scientific backstopping. Significant progress in understanding the fate of contaminants in the Black Sea has been made through a co-ordinated research programme. It resulted in a comprehensive and up-to-date assessment of inputs, space-time distributions, inventories and radiological effects of anthropogenic and natural radionuclides in the Black Sea. It also demonstrated the unique potential of radioactive and stable isotopes to trace and quantify the key processes which control the behaviour of pollutants affecting the life-support capacity, and hence the productivity, of the Black Sea ecosystem. Finally, it clearly indicated the need to upgrade the regional analytical and monitoring capacities for radionuclides in the marine environment. This need is being addressed through a regional technical co-operation programme, "Marine Environmental Assessment of the Black Sea Region". It involves the six IAEA Member States bordering the Black Sea: Bulgaria, Georgia, Romania, Russian Federation, Turkey, and Ukraine. Its main components support developing a regionally co-ordinated marine radioactivity monitoring programme and enhancing capabilities to investigate the fate of contaminants by using radiotracers. Joint research is focused on issues and areas identified as critical for the current status and future trends of Black Sea pollution, such as sedimentary processes on the northwestern shelf, in the Danube and Dnieper estuaries, mixing of water masses at the Bosphorus Strait, and ventilation of the deep anoxic waters.

The assessment of non-radioactive pollutants has been targeted by an IAEA/UNDP-GEF Inter-Agency Agreement. Its main objective is to assist the region's countries to obtain high quality analytical data for special and routine monitoring in the context of the BSEP. To this end, MEL, through its MESL Section, provides comprehensive technical support including the production of reference methods, organization of intercomparison exercises, distribution of reference materials and standards, training, instrument maintenance, quality assurance missions, and organization of expert meetings. MEL will continue to provide this support in the framework of the new Strategic Action Plan for the Rehabilitation and Protection of the Black Sea.

Global Programme of Action for Protecting the Marine Environment

About 80% of all marine pollution is caused by human activities on land — activities such as sewage disposal in rivers and the coastal ecosystem; inadequately treated waters from industries; discharges of nutrients of phosphorus and nitrogen used in agriculture and finally; heavy metals and persistent organic pollutants.States adopted the Global Programme of Action (GPA) for the Protection of the Marine Environment from Land-based Activities in 1995, an action that US Vice-President Albert Gore has said "is the first programme that will lead to more sustainable interaction between mankind and the world's oceans." Highlighted here are key features of the GPA and associated background information leading up to the programme's adoption.

Global and regional conventions and events related to protection of the marine environment

1976 Regional Seas Conventions and related Protocols, which today govern 15 Regional Seas Programmes
1982 United Nations Convention on the Law of the Sea (UNCLOS)
1989 Basle Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
1992 Convention on Biological Diversity
1992 United Nations Framework Convention on Climate Change
1992 United Nations Conference on Environment and Development (UNCED) and Agenda 21

In 1982, the United Nations Environment Programme (UNEP) started addressing issues related to impacts on the marine environment from land-based activities, resulting in the following conventions and decisions:

1985 Montreal Guidelines for the Protection of the Marine Environment Against Pollution from Land-based Sources
1995 UNEP Governing Council decisions 18/31 and 18/32 pertaining to the Washington Conference and Persistent Organic Pollutants (POPS)
1995 Conference to adopt a Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, Washington, DC, 23 October-3 November 1995

The Global Programme of Action

By adopting the Washington Declaration, more than 100 governments, and the European Commission, declared their commitment to protect and preserve the marine environment from the adverse environmental impacts of land-based activities. They called upon UNEP, the World Bank, the United Nations Development Programme (UNDP), the Regional Development Banks, and all agencies within the United Nations system, to support and strengthen the regional structures in place for the protection of the marine environment. They called upon UNEP, in close partnership with UNDP, the World Health Organization, Habitat, and other relevant organizations, to act as the Secretariat of the Global Programme of Action. The programme is designed to be a source of conceptual and practical guidance to be drawn upon by national and/or regional authorities in devising and implementing sustained action to prevent, reduce, control and/or eliminate marine degradation from land-based activities. It aims at preventing the degradation of the marine environment from land-based activities by facilitating the realization of the duty of States to preserve and protect the marine environment. More specifically, the GPA aims at:

- ***Identifying the nature and severity of problems caused by marine pollution.*** Analyzing the impact of marine pollution on (i) food security and poverty alleviation; (ii) public health, (iii) ecosystem health and biological diversity, and (iv) economic and social benefits and uses;
- ***Assessing the severity and impacts of contaminants.*** Includes sewage, persistent organic pollutants, radioactive substances, heavy metals, oils, nutrients, sediment mobilization and litter;
- ***Assessing the physical alteration, including habitat modification and destruction, in areas of concern;***
- ***Assessing the sources of degradation.*** They include (i) point sources, (e.g. waste-water treatment facilities or dredging operations); (ii) non-point sources, (e.g. urban or agricultural run-off); and (iii) atmospheric depositions caused by vehicle emissions, power plants and industrial facilities, incinerators and agricultural operations;
- ***Identifying areas which are affected or particularly vulnerable.*** Includes coastal watersheds, shorelines, estuaries and their drainage basins, and habitats of endangered species.
- ***Establishing priorities for action based on the identification and assessment of problems.***
- ***Defining specific management objectives, both with respect to source categories and areas affected, based on established priorities.***
- ***Identifying, evaluating and selecting strategies and measures.***
- ***Establishing criteria for evaluating the effectiveness of strategies and measures.***

What will the GPA do?

- Adapt existing regional and national action programmes, or promote and facilitate their development.
- Prepare a global review on the effects of land-based sources of pollution on the marine, coastal and associated freshwater environment. Identify "hot spots" for priority actions.
- Develop manuals and guidelines relevant to the implementation of the GPA.
- Organize and operate a clearinghouse prepared to respond to requests for assistance.
- Assist countries in (i) identification and formulation of project proposals; (ii) identification of potential donors; and (iii) negotiation with donors.
- Inform governments about problems related to land-based activities and the opportunities offered by the GPA. Support governments and non-governmental organizations alike, in the preparation and distribution of public awareness booklets and in setting up public awareness campaigns.

How will the GPA be implemented?

- Implementation will be addressed simultaneously at national, regional and global levels;
- Formulation of national, sub-regional and regional action programmes will be the cornerstone for successful implementation;
- Financial sources and mechanisms are to be addressed both at the State level (e.g. charging the polluter, revolving funds, private sector participation) and at the international level (e.g. multilateral loans and debt-for-equity swaps).

How can the IAEA contribute to the GPA?

The IAEA has followed the underlying principles of GPA for many decades. It has paid close attention to the quantification and reporting of inputs of radioactivity to the oceans and, through the Marine Environment Laboratory (MEL), to the monitoring and assessment of the consequences of these inputs. The Agency is therefore in an excellent position to contribute meaningfully to the GPA. From the IAEA Division of Radiation and Waste Safety, the following contributions have been proposed:

- Development of standards for controlling discharges of radioactive materials to the marine environment;
- Acquisition and dissemination of information on options, methods and technologies for the control of discharges;
- Development of inventories of worldwide discharges of radionuclides from nuclear installations and other, non-nuclear, facilities into the environment, including the marine environment;
- Assessment of the impact of discharges;
- Regular publication of data on discharges and their environmental impacts.

From MEL, the contributions combine the mainstream activities on marine radioactivity with inter-agency collaboration on a wide range of non-nuclear contaminants, as follows:

- Training and capacity building to extend the capabilities of Member States to monitor, understand and assess marine radioactivity;
- Provision of analytical quality control services by distributing a wide range of intercomparison and reference materials to laboratories worldwide;
- Maintenance of, and the provision of global access to, a comprehensive computer database on radioactivity in the marine environment, including intelligent functions to model dispersions from individual source-terms and to identify and explain spatial and temporal trends in marine radionuclide distributions;
- Quantification of the radiological (health-related) consequences of known inputs of radioactivity to the oceans by a combination of direct measurement, modelling and radiological assessment;
- Provision of an international emergency response function to assist on request with monitoring and evaluation of unplanned marine radioactivity inputs, including improvement of methodologies for continuous monitoring of marine radioactivity;
- The improvement of the understanding of the oceans, their circulation and the behaviour of pollutants by using the unique timing and tracing potentials of marine radionuclides and stable isotopes.

Building on the expertise available at MEL — and on the experience gained in more than 15 years of collaboration with UNEP and IOC-UNESCO on the assessment and monitoring of pollutants in the marine environment, including particularly the quality control of obtained data — the IAEA can assist in a number of activities relevant to the implementation of the GPA:

- Organization and implementation of data quality assurance programmes ensuring that assessments of major marine contaminants from land-based sources (including POPs, trace elements, oil) are reliable and intercomparable on regional and global levels;
- Preparation and testing of reference methods and guidelines for marine pollution assessment and monitoring;
- Design of national and regional marine pollution monitoring programmes;
- Training in analytical chemistry relevant to research and monitoring of marine pollutants; and
- Strengthening or establishment of regional technical support centres relevant to marine pollution research and monitoring.

measurements of contaminants in standard reference materials and participation in intercomparison and intercalibration exercises. MEL is a worldwide centre for quality assurance data for all types of chemical contaminants, both nuclear and non-nuclear. It also conducts regional exercises for quality assurance in the Mediterranean, the Persian Gulf area, the western and southeast Pacific, west and central Africa, east Africa, southeast Asia, the Caribbean, the southwest Atlantic, the Arctic, and the Baltic and Black Seas.

Scientific investigators associated with such intercalibration exercises have reported approximately 100,000 measurements since 1971 for specific contaminants in seawater, sediment, seaweed, plants, fish and other organisms. Participating laboratories have increased from approximately 50 in total in 1970 to 208 different laboratories now analyzing radionuclides, trace organics, and trace elements. Some 60 different intercomparison materials are available.

Reference materials. Samples of marine materials certified as reference materials for certain analytes (radionuclides, trace metals, chlorinated hydrocarbons, etc.) are used in quality control programmes. Together with UNEP and the IOC-UNESCO, the IAEA works closely with other producers of reference materials to assure a continuous supply of these vital elements of quality assurance procedures. A full catalogue of some 600 standards and reference materials are banked in Monaco.

Reference methods. One difficulty faced by many analysts starting studies in marine contamination is finding a reliable method that uses readily available, and serviceable, instruments. Working with several UN agencies, MEL edits and tests reference methods. The series now includes more than 70 volumes that are available around the world.

Improving quality of data. Despite progress so far in national laboratories to accurately measure marine contaminants, more needs to be done, for example, in the analysis of organic pollutants such as chlorinated pesticides and petroleum hydrocarbons. The needs include improved training of analysts, further advances in analytical techniques, and intensified production of intercomparison samples and marine reference materials.

All of the services provided by MEL have become essential to the operation of the UNEP and IOC-UNESCO regional and global pollution assessment programmes. They particularly provide relevant support to UNEP issues of integrated coastal area management and to the assessment of pollution from land-based sources. As importantly, they support the work of the IOC-UNESCO, UNEP, IAEA, and International Maritime Organization related to the programme for the Global Investigation of Pollution in the Marine Environment.

Moving into the 21st century

In 1998, MEL will enter a new stage in its development with the opening of purpose-designed laboratory premises, which will more than double floor space, consolidate three Lab Sections into one building and improve facilities substantially, including a new training centre. As a contribution to the UN's International Year of the Ocean to be marked in 1998, MEL will host an inter-agency symposium on marine pollution next year.

The new laboratories position MEL to play an even stronger leadership role in key areas of scientific interest to IAEA Member States. These include:

- ***Using isotope techniques to study non-nuclear contaminants.*** Particular attention will be devoted to understanding marine pollution by organic compounds such as oils, sewage and fossil fuel consumption products and delineating key processes in the transport of carbon to the ocean depths.
- ***Development of a marine information system.*** Using the latest information technology and working with other UN agencies, a comprehensive, computer-based system for mapping, analyzing and forecasting marine pollution will link GLOMARD to other major databases.
- ***Employing revolutionary methodologies.*** On-site radioactivity monitoring with satellite data transmission will allow continuous surveillance of remote study locations, while a new generation of submersible detectors mounted on remotely operated vehicles will permit detailed inspection of seabed radioactivity. MEL will also develop and use ultra low-level radioactivity counting techniques located in a new underground laboratory.
- ***Increasing training and capacity building.*** Using the new Training Centre in Monaco, and stimulated by the challenges of the new GPA, the IAEA's Marine Environment Laboratory will consolidate and extend its leading position as the United Nations' centre of training and analytical quality assurance for the assessment of marine pollution. ❐