



**IAEA**  
International Atomic Energy Agency

# Marine Environment News



A newsletter of the IAEA Marine Environment Laboratory, Monaco  
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*IAEA Marine Environment Laboratory, located on floors 2 & 3 of Monaco's Quai Antoine I building.*

## Director's Introduction



Welcome to our first issue of the IAEA's Marine Environment Newsletter which we hope will inform our Member States, research partners, visitors and other stakeholders of highlights of the marine projects, surveys, hot issues, discoveries and training programmes being delivered by the IAEA's Marine Environment Laboratory (MEL) in Monaco. We hope you find this Newsletter informative and useful and we look forward to any feedback.

When IAEA's Director General Mr. Mohamed ElBaradei appointed me to lead the MEL in Monaco, I was handed the privilege of directing the UN's only Marine Laboratory, with its outstanding reputation in marine radioactivity studies, protection of the marine environment and innovations in analytical techniques. The challenge now is to chart a new vision and partnerships which deliver the latest generation of nuclear and isotopic technologies to enable Member States to protect and develop their marine environments.

In this endeavor we are fortunate in being generously supported by the Principality of Monaco and in being part of the IAEA's Department of Nuclear Sciences and Applications, which allows for creative and integrated environmental studies.

What is the Mission of the Marine Environment Laboratory? We are charged with providing Member States with:

- Research for the protection of the marine environment from radioactive and non-radioactive pollution

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- Applications of nuclear & isotopic techniques for tracking oceanic processes, understanding marine ecosystems and assessing pollution impacts.
- Expertise, training & Reference Materials essential for Member States' commitment to the sustainable development and monitoring of their marine environments.
- Strategic partnerships with international organisations and other UN ocean agencies (IOC/UNESCO, UNEP, UNDP, IMO) to deliver the UN-WSSD programs on sustainable development of the ocean.

In recent years, the MEL has carried out world-wide radioactivity baseline studies (see below) which have covered the Atlantic, North & South Pacific, Indian, Arctic and Antarctic Oceans and the Mediterranean, Black and Caspian Seas. Regional environmental 'hotspots' such as the Gulf, the Irish, Kara and Caspian Seas, New Caledonia and the Muroroa and Fangataufa Atolls have also been investigated in detail. We have derived unique marine radioecological datasets which enable us to model and predict radionuclide pathways and

risks through marine foodchains. Over the last year, MEL has cooperated with 52 Member States and our results have appeared (see publications list and hotlinks on page 7) as IAEA Reports and as research publications in international peer reviewed journals with worldwide citation. This, of course, is the cornerstone of reliable science audit. Member States need to know that the marine environmental research they support is of the best scientific quality, relevance and independence.

Our 2004-2005 Biannual Programme is fully described on our Web Site ([www.iaea.org/monaco](http://www.iaea.org/monaco)). We shall enhance our core function as the Agency's Marine Environmental Watchdog. We shall continue our thrust in innovative analytical and oceanographic studies to provide high quality advice to Member States. In the long run we shall develop new nuclear and isotopic applications with intra-Departmental, international (UN, EU...) and private sector partners focusing on coastal zone management, pollutant cocktails, climate change, harmful algal blooms, sustainable aquaculture and marine protection for desalination. *R Fauzi C Mantoura, Director ([F.Mantoura@iaea.org](mailto:F.Mantoura@iaea.org))*

## MEL Completes The First Global Ocean Radioactivity Baseline Study

A project on Worldwide Marine Radioactivity Studies (WOMARS), which also included a Co-ordinated Research Programme (CRP), was carried out in 1995 – 2002 by the Radiometrics Laboratory.

The primary objective was to develop an understanding of the present open ocean distribution of anthropogenic radionuclides in the water column and sediment, and predict the associated radiological impact. The project aimed to encourage and support marine radioactivity studies in Member States by methodological assistance and total analytical quality management.

The investigation programme was designed with the intention of reviewing and contributing to scientific knowledge of the processes which affect radionuclide distributions and the sources which have introduced anthropogenic radionuclides to the world's oceans..

The specific objectives of the project were to: identify the major sources of anthropogenic radionuclides in the world's oceans; develop present knowledge of the distributions of key radionuclides in water and sediment of the world's oceans; extrapolate the results from contemporary ocean-wide surveys such as the tracer component of the World Ocean Circulation Experiment Hydrographic Programme (WOCE); and study the evolution of radionuclide concentrations in water with time using good quality historical data (e.g. from the GEOSECS programme

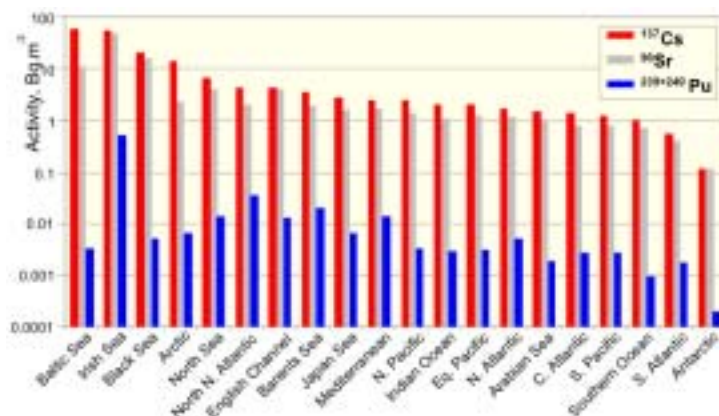
of the mid-1970s and new data sets). Three anthropogenic radionuclides,  $^{90}\text{Sr}$ ,  $^{137}\text{Cs}$  and  $^{239,240}\text{Pu}$ , have been chosen as the most representative of anthropogenic radioactivity in the marine environment, comprising beta-, gamma- and alpha-emitters which have the highest potential contribution to radiation doses to humans via seafood consumption.

The success of the project was due to the active collaboration of 35 scientific institutions and agencies from 15 Member States, which organised 12 oceanographic expeditions, analysed hundreds of marine samples and which provided new radionuclide data for the project.

The data obtained were evaluated and stored in the IAEA's Global Marine Radioactivity Database (GLOMARD), which will be accessible to Member states via Internet in 2004.

The results obtained in the framework of the WOMARS project provide the most complete dataset available to Member States on levels of radionuclides in the marine environment (see graph).

The dominant sources of anthropogenic radionuclides in the European Seas are nuclear reprocessing plants in Sellafield (UK) and La Hague (France), and the Chernobyl accident. On the global scale, the dominant source of anthropogenic marine radioactivity is global fallout from the atmospheric nuclear weapons tests carried out mainly in the fifties and early sixties. The WOMARS results have recently been used



*Averaged  $^{137}\text{Cs}$ ,  $^{90}\text{Sr}$  and  $^{239+240}\text{Pu}$  activity concentrations in surface water of the world's oceans and seas in the year 2000.*

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within the EC MARINA II project assessing the radiological impact from marine food for inhabitants of the European Union. The estimated radiation doses from marine pathways to critical groups in the region have been found to be below the annual dose threshold for the public recommended by the European Council. The WOMARS results have been published in technical documents and in over 40 papers in peer-reviewed journals and proceedings, including a special issue of the journal *Deep Sea Research II*.

The results will be used as an international reference source on the average levels of anthropogenic radionuclides in the marine environment so that any further contributions from nuclear reprocessing plants, radioactive waste dumping sites,

nuclear bomb test sites and possible nuclear accidents can be identified.

The MEL would like to express its gratitude to collaborating institutions for the information provided and for the most fruitful collaboration during sampling expeditions, analysis of collected samples and data evaluation. A generous support provided by the Science and Technology Agency of Japan (presently the Ministry of Education, Culture, Sport, Science and Technology) made this large scale project possible.

For further information please contact [P.Povinec@iaea.org](mailto:P.Povinec@iaea.org). More information about the published papers can be found on [www.iaea.org.monaco](http://www.iaea.org.monaco) and in the WOMARS special issue of *Deep Sea Research II*, 2003.

## Organotin Antifoulants In The Gulf Region Found To Be Within Safe Limits

As the only marine laboratory in the UN system, the IAEA Marine Environment Laboratory often gets requests to assist with investigating non-radioactive marine pollution issues. The study described here was prompted by the concerns of various Member States in the Gulf region. The work was co-sponsored by the IAEA and the Regional Organisation for the Protection of the Marine Environment (ROPME).

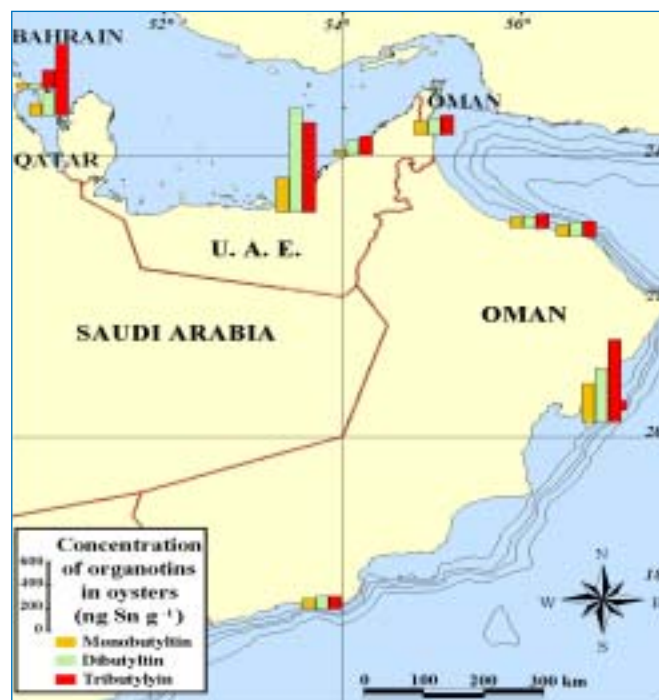


*Rock oysters at Masirah, Oman.*

Organotin compounds have been widely utilised as biocides, and in particular, tributyltin (TBT) compounds act as the main active ingredient in many marine antifouling paints. TBT contamination causes shell deformation in Pacific oysters and the development of imposex (*i.e.* the imposition of male sex organs on females) in marine gastropods.

Organotin-based paints have been used on boats of all sizes, from small yachts to supertankers, thereby causing the global dispersion of TBT throughout the marine environment, from the coastal zone to the open ocean. These compounds are persistent in the marine environment owing to their slow degradation rates and consistent flux. Sediments provide a valuable means to assess contamination and given the public health concerns, seafood analyses are prudent. The Gulf and Gulf of Oman comprise a special marine environment, with marine ecosystems that are relatively fragile and dense shipping owing to the large number of oil tankers that transit the region.

Butyltin species were measured in sediments from coastal locations in The Gulf and Gulf of Oman. With tributyltin (TBT) concentrations up to 60 ng Sn g<sup>-1</sup>, some sediments can be classified as contaminated (*i.e.* TBT > 1.3 ng Sn g<sup>-1</sup>), namely those sampled at Dukhan (Qatar), the BAPCO industrial complex and Askar (Bahrain), and Hilf and the Raysut Port Area (Oman).



*Concentrations of organotin compounds in oysters from Bahrain, Qatar, UAE and Oman.*

Both butyltin and phenyltin species were measured in biota samples from four countries in this region. Higher concentrations of total butyltins were found in oysters relative to fish, but ranging from 6.5 to 488 ng Sn g<sup>-1</sup> dry weight they are nonetheless relatively low. Diphenyltin (DPHT) and triphenyltin (TPHT) were found in some fish and bivalves from The Gulf, but not in biota from the Gulf of Oman.

The environmental levels of organotin species are comparatively low by global standards and pose no immediate public health problems to the region. *For further information, please contact* [S.J.de-Mora@iaea.org](mailto:S.J.de-Mora@iaea.org)

\* **Full article:** *Assessment of Organotin Contamination in Marine Sediments and Biota from The Gulf and Adjacent Region* by S.J. de Mora, S.W. Fowler, R. Cassi & I. Tolosa, *Marine Pollution Bulletin* **46** (2003) pp. 401-409.

# Climate Change: Natural Radionuclides Help Quantify Ocean Carbon Sinks

An international project aiming to improve the understanding of the mechanisms by which the ocean plays a major role in carbon sequestration is ongoing with the participation of several academic institutes from the USA and Europe, and the IAEA-Marine Environment Laboratory\*. The main objective of the project is to study the biological processes involved in carbon sequestration in oceanic surface waters and to assess the influence of minerals (either produced by organisms or introduced in the ocean surface by winds and rain) on carbon export to the deep ocean and sediments.



*The R/V Seward Johnson II in the Mediterranean. The 56 m long American ship is run by Harbor Branch Oceanographic Institution.*

The project, named MEDFLUX, started in 2002 for a period of three years and is largely financed by the USA National Science Foundation. The contribution of MEL's Radioecology Laboratory to the project is based on the laboratory's experience in the measurement of particle flux in the oceans using sediment traps and natural radionuclides, and its long time-series of results from studies at the selected sampling site, which is in the Mediterranean near Monaco.

Sinking particulate matter is the major vehicle for exporting carbon from the sea surface to the ocean interior. During its transit towards the sea floor, most particulate organic carbon is remineralized to the inorganic form and redistributed in the water column. This redistribution determines the surface concentration of dissolved CO<sub>2</sub>, and hence the rate at which the ocean can absorb CO<sub>2</sub> from the atmosphere. The ability to predict quantitatively the depth profile of remineralization is therefore critical to predicting the response of the global carbon cycle to environmental change.

Carbon export from surface waters can also be indirectly determined using the disequilibrium of the natural radionuclides <sup>234</sup>Th and <sup>238</sup>U in the uranium series. <sup>234</sup>Th is produced continuously in seawater from the decay of <sup>238</sup>U. The <sup>234</sup>Th thus produced becomes quickly attached to particles and is removed from the surface waters with the settling particles. This preferential removal of <sup>234</sup>Th causes its activity to be deficient relative to its parent <sup>238</sup>U in the upper water column. The extent of this deficiency, in conjunction with data on organic carbon and <sup>234</sup>Th in particulate material, permits determining the export production and particulate carbon removal from surface waters.

The sampling area has served as a reference site for REL scientists and French CNRS colleagues for over 15 years. Several sampling cruises took place this year 50 km off Monaco in the Central Ligurian Sea (for details see "Cruises" on p. 5). A final cruise on board R/V Téthys II is planned later this year to complete the series of measurements. During the cruises, water column profiles of dissolved and particulate <sup>234</sup>Th, <sup>210</sup>Po, <sup>210</sup>Pb and <sup>226</sup>Ra were sampled from the surface to the bottom at 2300 m using Niskin bottles and in situ pumps. Samples from the upper 200 m will help to assess carbon export from the euphotic or well-lit layer, whereas data from the bottom area will help understand resuspension of particles from the sediments.

Moored automatic sediment traps were deployed from March to July at several depths to collect time-series information on the vertical flux of particulate material and to run particle settling velocity experiments. A newly designed drifting net-trap was successfully used to collect fresh biological material needed for experimental work on board. The samples were initially processed on board and are currently being analyzed at MEL and MSRC for the natural radionuclides, organic and inorganic carbon, and total pigment composition. Subsamples of the collection are also analyzed by the other laboratories participating in the project for an array of biogeochemical parameters including carbohydrates, lipids, amino acids, biogenic silica and trace metals. For further information, please contact [J.C.Miquel@iaea.org](mailto:J.C.Miquel@iaea.org)



*Field sampling large volume in-situ pump to collect particulate material and the dissolved phase of specific elements.*

\* The laboratories participating in the project are (including in brackets the name of principal scientists): 1) Marine Sciences Research Center, New York State University, USA (Drs. Cindy Lee, Kirk Cochran, Robert Armstrong), 2) Skidaway Institute of Oceanography, Savannah, USA (Dr. Stuart Wakeham), 3) School of Oceanography, University of Washington, USA (Mr. Michael Peterson), 4) Instituto de Tecnología Ambiental, Universitat Autònoma de Barcelona, Spain (Dr. Pere Masque), and 5) MEL, Monaco (Drs. Juan Carlos Miquel, Scott Fowler and Beat Gasser, Ph.D. student Alessia Maria Rodriguez y Baena). Other laboratories collaborating in the project are 6) Centre d'Océanologie, Université de Marseille, France (Dr. Madeleine Goutx), 7) Institut Européen de la Mer, Université de Bretagne, France (Dr. Olivier Raqueneau), and 8) Technical University of Hamburg, Germany (Dr. Ghieseler Gust).

# Radiotracers For Pollutant Bioaccumulation: A New Co-Ordinated Research Project (CRP)

In coastal pollutant monitoring programmes at both the national and regional level, many institutions use bio-indicator organisms as a tool for monitoring changes in water quality. While these pollution sentinel species have proven extremely useful in serving as an early warning system for the presence of contaminants such as heavy metals, radionuclides and pesticides, accurate interpretation of the bio-monitoring data they produce is often difficult to achieve. The cause is the lack of adequate understanding of the biological and environmental parameters which control contaminant bioaccumulation in the organism. Parameters such as contaminant uptake and excretion rates, and the many variables that affect these parameters (i.e., temperature, salinity, season, sexual state) are often unknown and are difficult to measure in the field. However, the use of radiolabeled contaminants under controlled laboratory conditions offers a rapid and cost-effective method for making the required measurements.

To address these questions, within the IAEA's Marine Environment programme, a new CRP entitled "Nuclear

applications to determine bioaccumulation parameters and processes used for establishing coastal zone monitoring and management criteria" was launched in mid-year.

This CRP specifically aims to co-ordinate efforts in using state-of-the-art experimental radiotracer techniques to assess the bioaccumulation and excretion parameters for contaminants in potential bio-indicator species, particularly those in tropical waters, so that bio-monitoring data on contaminant levels in these organisms and their variability over time are properly interpreted. Such information is vital for establishing coastal zone monitoring and management criteria for protecting the marine environment. The CRP is scheduled to run for two years and research contracts and agreements have been awarded to institutes from 9 member states (Australia, Brazil, Cuba, Indonesia, Korea, Pakistan, Philippines, Thailand and USA). To kick off the CRP, the first research coordination meeting will be held at MEL 2-5 December 2003.

For further information, please contact [S.Fowler@iaea.org](mailto:S.Fowler@iaea.org)

## Major Research Cruises

**MEDFLUX cruises in the Mediterranean**, March 3-5 and June 30-July 1, 2003 onboard R/V Tethys II and May 5-14, 2003 onboard R/V Seward Johnson II. Participants: Juan Carlos Miquel, Beat Gasser, Alessia Maria Rodriguez y Baena. Objective: see article on page 4.

**Barents Sea**, September 16 - October 13, 2003 onboard R/V Walther Herwig III. Participants: Beniamino Oregioni and Isabelle Levy. Objective: studies of radionuclide distributions in the water column through collection and analysis of large-volume water samples for determinations of plutonium, americium, cesium, strontium,  $^{14}\text{C}$ ,  $^3\text{H}$ .

**Southern Ocean**, November 6, 2003-January 18, 2004 onboard R/V Mirai. Participants: Sang-Han Lee, Beniamino Oregioni and Janine Gastaud. Objectives: to investigate global climate change using isotope tracers and to study levels and distributions of anthropogenic radionuclides.

**Southern Ocean**, November 15, 2003-January 17, 2004 onboard R/V Polarstern (EASIZ). Participant Alessia Maria Rodriguez y Baena. Objectives: study of natural radionuclides in the water column, surface sediments and biota to assess particle and carbon export processes in the Weddell Sea.

## Technical Co-operation Activities

MEL currently works together with the Agency's Technical Co-operation Department to implement 18 Technical Co-operation projects aiming to improve Member States' capabilities in the application of nuclear and tracer techniques to marine environmental studies. A full list of marine TC projects underpinned by MEL can be found on [www.iaea.org/monaco](http://www.iaea.org/monaco). For further detail on the Technical Co-operation Programme please visit [www-tc/tcweb](http://www-tc/tcweb). A few recent developments are presented in the following:

### Nuclear techniques in support of Coastal Zone Management in Asia and the Pacific

This year a new regional project dealing with coastal marine pollution and management issues was initiated under the Agency's Regional Cooperative Agreement (RCA) for Asia and the Pacific. The project entitled "Enhancing the Marine Coastal Environment and its Pollution" (RAS/7/011) includes three

components which are closely linked to MEL's programmes. The first augments the regional database for radionuclides in seawater, sediments and biota, the second applies different nuclear techniques to track pollutants in heavily contaminated coastal zones, and the third aims to transfer to more Member

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States the application of radiolabeled receptor binding assays (RBA) for identifying algal toxins. In March a project formulation meeting was held in Kuala Lumpur where the representatives of the 11 participating countries agreed on a workplan based on the approved budget for the 2-year regional project. To instruct in the use of nuclear and isotopic techniques to assess the sources and dispersion of pollutants, a regional training course will be held 20-29 October 2003 at the Philippines Nuclear Research Institute in Manila.

The site selected for the field training exercise is Manila Bay, a water body receiving a wide variety of pollutants from the heavily populated area around it. Following this specialized training, each participant will then concentrate on carrying

out similar studies in priority areas in their own countries. In the case of harmful algal bloom (HAB) issues, it was decided to link these activities wherever possible to other regional programmes such as the IAEA regional project on producing radiolabeled algal toxins for receptor binding assays (INT/7/015) and those activities carried out by UNESCO - IOC. In addition to RBA development, sediment cores from areas where HAB outbreaks have occurred will be dated using the  $^{210}\text{Pb}$  technique in order to obtain a history of algae production peaks which can be determined from sedimented algal cysts. Knowledge of previous cycles of HAB occurrences could lead to a better capability for predicting such events in the future.

For further information please contact [S.Fowler@iaea.org](mailto:S.Fowler@iaea.org)

## Marine Radiochemistry National Training Course in Sudan



*Students worked in small groups to carry out radioanalytical work for the analysis of a marine sediment reference material*

Organized by the Sudan Atomic Energy Commission (SAEC) in July 2003 in Khartoum, this 2-week NTC was designed to provide an introduction to the measurement of low concentrations of radionuclides in the environment. Fifteen participants from various local scientific institutions took part. A MEL Research Scientist was invited as instructor under TC project RAF/0/018. During the first week, the IAEA expert presented lectures in chemical separation methods, counting techniques, alpha and gamma spectrometry, data evaluation, and radioactive growth and decay relationships. In addition, practical experimental work was performed by the participants using IAEA-384 Fangataufa atoll sediment reference material. The successful laboratory exercise clearly illustrated all of the main aspects of a typical radiochemical analysis. For further information please contact [JeLaRosa@iaea.org](mailto:JeLaRosa@iaea.org)

## Responding to Aquatic Environmental Emergencies

A new regional project targeting IAEA Member States of the Regional Co-operative Agreement for Research, Development and Training related to Nuclear Science and Technology for Asia and the Pacific (RCA) was initiated this year. The project, entitled "Improving Regional Capacities for Assessment, Planning and Responding to Aquatic Environmental Emergencies" (RAS/8/095), will improve regional capacities for computer modelling and assessing contamination in coastal aquatic environments.

In July, a project formulation meeting was held in Sydney where the representatives of twelve Member States discussed and agreed on a workplan for 2003-2004, based on the approved budget with an extrabudgetary contribution from the Australian Government. Radionuclide tracers dispersion experiments in selected coastal sites, and subsequent in situ mapping of gamma-radionuclides in water and sediment will be carried out to validate computer models for assessing and predicting radioactive and non-radioactive contamination in

coastal zones. Two expert missions and two regional workshops are planned for 2003-2004. The Yellow Sea was selected as a first demonstration site for the project, where radionuclide dispersion studies will be carried out. For further information, please contact [S.Lee@iaea.org](mailto:S.Lee@iaea.org)



*Participants in the IAEA/RCA Project formulation meeting, hosted by the Australian Nuclear Science and Technology Organisation (ANSTO) in Sydney, Australia, July 2003*

## Up-coming Meetings

**International Conference on Isotopes in the Environment: Tracking Marine and Freshwater Ecosystems,** 29 August – 3 September 2004, Monaco. More information on [www.iaea.org](http://www.iaea.org).

## Training Courses

MEL has a long history of organising training courses for Member States, regional organisations and other UN organisations. They cover a range of topics related to the application of radionuclides in marine studies and the analysis of non-radioactive pollutants. Some recent courses and those planned for 2003 are listed below. For further information please contact [S.Henry@iaea.org](mailto:S.Henry@iaea.org).

Location	Course Title	Date
MEL Monaco	MEDPOL – sponsored course for the analysis of organic contaminants in the marine environment	June 2003
Central Environmental Laboratory in Doha, Qatar	ROPME – sponsored course for the analysis of metals in the marine environment	June 2003
SAEC, Khartoum, Sudan	National Training Course for environmental analytical radiochemistry (see article on page 5)	July 2003
MEL Monaco	MEDPOL – sponsored course for the analysis of metals in the marine environment	October 2003
Nuclear Research Institute, Manila, Philippines	IAEA-TC – sponsored course for the assessment of sources and dispersion of pollutants	October 2003
MEL Monaco	MEDPOL – sponsored course for the analysis of organic contaminants in the marine environment	November 2003

## Current Intercomparison Exercises

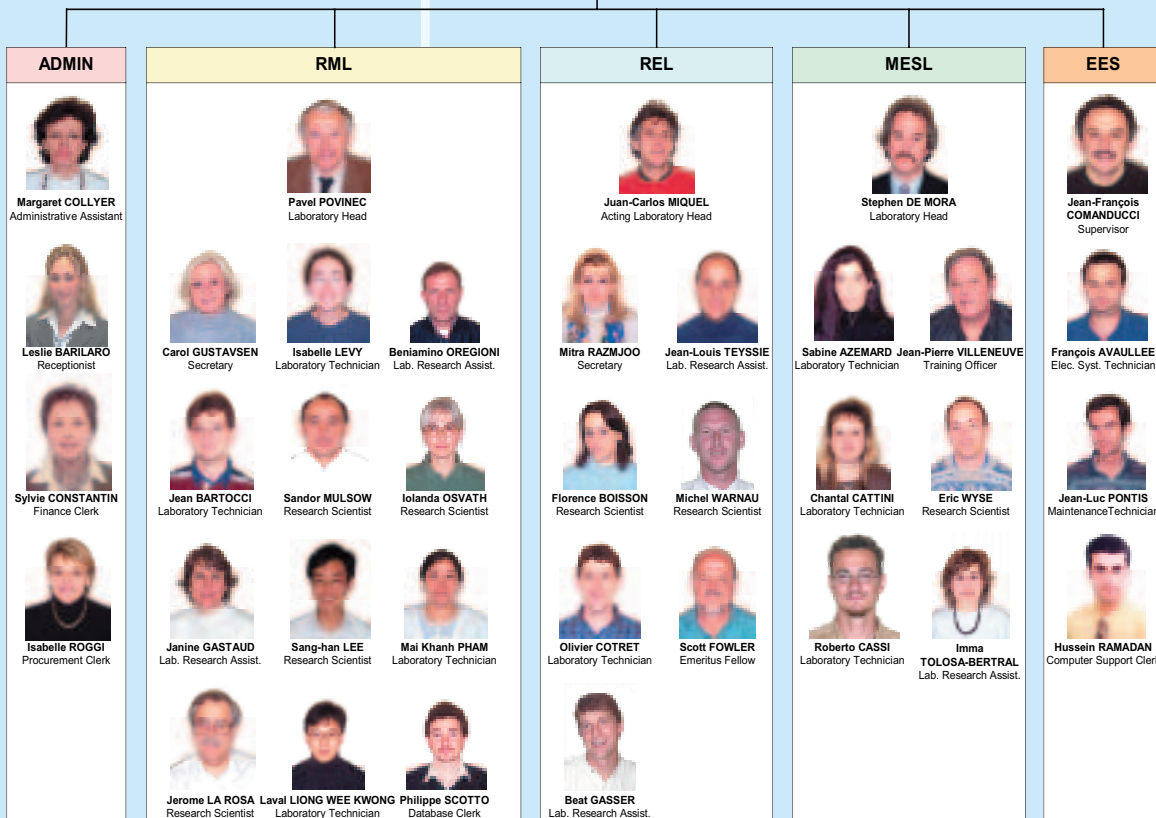
For almost three decades MEL has been running a programme of intercomparison (IC) exercises and proficiency tests for the analysis of radionuclides, organic contaminants and metals in various marine media. The IC exercises range from global scale, with typically 150 laboratories taking part, to regional scale, involving dozens of laboratories, and to project-dedicated exercises, involving in the order of 10 participants. Intercomparison materials are distributed free of charge to participating laboratories. IC exercises allow laboratories to evaluate their performance and improve the quality of their data. They constitute a key resource for marine laboratories, due to the specific analytical requirements for contaminants in marine matrices. MEL is also one of the few producers of marine reference materials in the world. For further information please contact [P.Povinec@iaea.org](mailto:P.Povinec@iaea.org) (radionuclides) or [S.J.de-Mora@iaea.org](mailto:S.J.de-Mora@iaea.org) (organic contaminants and metals).

Sample	Matrix	Status
IAEA-385	Radionuclides in Irish Sea sediment	Report in 2004
IAEA-407	Trace elements and methylmercury in fish homogenate	Completed February 2003
IAEA-410	Radionuclides in Bikini Atoll sediment	Sample distribution in 2005
IAEA-412	Radionuclides in Pacific Ocean sediment	Sample distribution in 2004
IAEA-414	Radionuclides in Irish and North Sea fish	Report to be completed in October 2003
IAEA-415	Radionuclides in North Atlantic fish	Sample distribution in 2004
IAEA-418	Iodine-129 in Mediterranean seawater	Deadline for results: November 30, 2003
IAEA-432	Petroleum hydrocarbons and organochlorinated compounds in mussels	Deadline for results: September 30, 2003
IAEA-433	Trace elements and methylmercury in marine sediment	Deadline for results: September 30, 2003
IAEA-435	Petroleum hydrocarbons and organochlorinated compounds in tuna fish muscle	To commence in late 2003
IAEA-436	Trace elements and methylmercury in tuna fish muscle	To commence in late 2003



## IAEA Marine Environment Laboratory Structure and Staff

ADMIN: Administration  
RML: RadioMetrics Laboratory  
REL: RadioEcology Laboratory  
MESL: Marine Environment Studies Laboratory  
EES: Engineering and Electronics Support



In addition to the listed staff, MEL currently hosts 4 fellows and 3 post-graduate students attached to MEL research teams.

### MEL Info:

For further detail on IAEA-MEL programmes and activities and to obtain a full list of publications or reprints please refer to MEL's homepage <http://www.iaea.org/monaco> or write to:

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### Selected Recent MEL Publications

Over the period 1997-2002 the IAEA-Marine Environment Laboratory has published 225 research papers in the international peer reviewed journals. The complete publication list is found on our website. A list of selected recent publications is given below.

- Anthropogenic radionuclides in the Caspian Sea, Oregioni, B., Gastaud, J., Pham, M.K., Povinec, P.P. *Water Resources*, 30(1): 86-91 (2003).
- Distribution of sterol and fatty alcohol biomarkers in particulate matter from the frontal structure of the Alboran Sea (SW Mediterranean Sea), Tolosa, I., LeBlond, N., Copin-Montégut, C., Marty, J.-C., de Mora, S.J., Prieur, L. *Marine Chemistry*, 82: 161-183 (2003).
- Fractionation of <sup>210</sup>Po and <sup>210</sup>Pb in coastal waters of the NW Mediterranean continental margin, Tateda, Y., Carvalho, F.P., Fowler, S.W., Miquel, J.-C. *Continental Shelf Research*, 23: 295-316 (2003).
- Modelling the distribution of plutonium in the Pacific Ocean, Nakano, M., Povinec, P.P. *NIM* 69: 85-106 (2003).
- Radiometric dating of sediment cores from a hydrothermal vent zone off Milos Island in the Aegean Sea, Ugur, A., Miquel, J.-C., Fowler, S.W., Appleby, P. *The Science of the Total Environment* 307: 203-214 (2003).
- Temporal studies of biochemical processes - determined from ocean time-series observations during the JGOFS Era, Karl, D.M., Bates, N.R., Emerson, S., Harrison, P.J., Jeandel, C., Llinas, O., Lui, K.-K., Marty, J.-C., Michaels, A.F., Miquel, J.-C., Neuer, S., Nojiri, Y., Wong, C.S. *Ocean Biochemistry: The Role of the Ocean Carbon Cycle in Global Change* - M.J.R. Fasham, ed., Springer: 239-267 (2003).
- World-wide intercomparison on the determination of chlorinated pesticides, PCBs and petroleum hydrocarbons in sediment sample IAEA-417, Villeneuve, J.-P., de Mora, S.J., Cattini, C. *Environmental Technology* 23: 1203-1217 (2002).