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Marine Environment News

A newsletter of the IAEA Marine Environment Laboratory, Monaco
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Contents

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New Head for Radioecology Laboratory

Dr Ross Jeffree has recently taken up the position of Laboratory Head, Radioecology Laboratory at MEL. Ross was previously employed at the Australian Nuclear Science & Technology Organisation (ANSTO) as Leader of its Coastal Zone Project and Environmental Biology Group. He brings with him over 30 years of research experience in the field of aquatic radioecology and its applications to ecotoxicology. His previous research interests include the impacts of uranium mining in tropical environments on the bioaccumulation of radionuclides and metals in aquatic foods. The applications of radiotracers and other nuclear-based technologies to the development of bioaccumulation models and the use of biota as contemporary and archival monitors of water quality have also been long-term interests. Another area of research that will continue at MEL is the effect of oceanic biological productivity on the biogeochemical cycling of radionuclides. During his nuclear-based career, Ross was also Counsellor Nuclear at the Australian High Commission, London, for three years and subsequently Coordinator of the Environmental Impact Statement for ANSTO's Replacement Research Reactor. *For further information, please contact R.Jeffree@iaea.org*

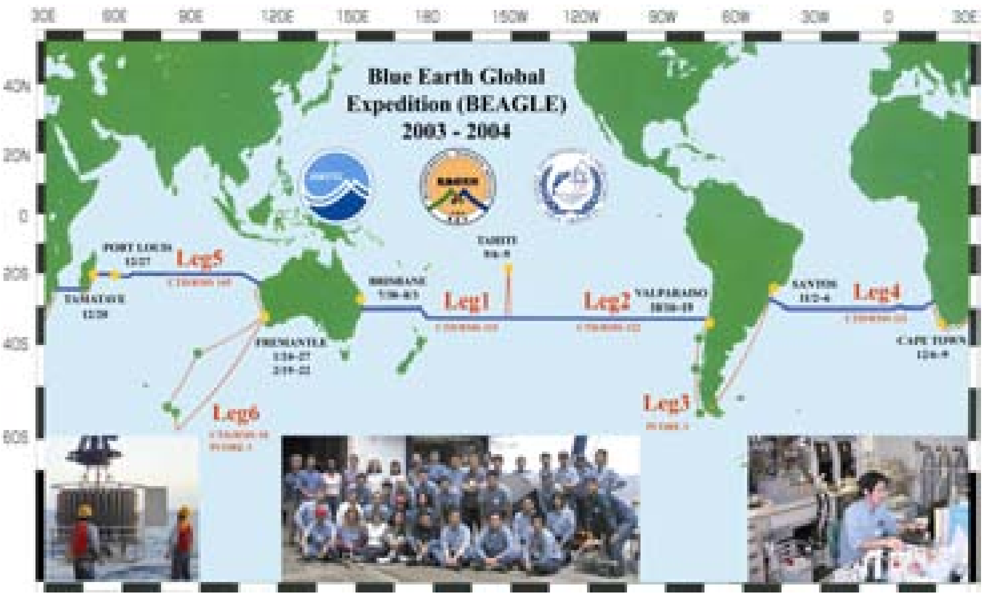
Ross Jeffree, Radioecology's new Laboratory Head

Guest Article: Tracers to Reveal Global Role of Southern Oceans in Climate Change

The main global source of anthropogenic radionuclides in the marine environment is global fallout from atmospheric nuclear tests carried out between 1945 and 1980. Several global studies have been carried out in the world oceans, however the Oceans in the Southern Hemisphere have not been covered well and data on the distribution, inventory and behaviour of anthropogenic radionuclides have been missing.

Objectives of Japan – IAEA Joint Investigations

Therefore one of the objectives of the first global expedition for radionuclide tracer studies in the Southern Hemisphere Oceans, the Blue Earth Global Expedition (BEAGLE), conducted on the R/V MIRAI during August 2003 – March 2004 (Fig. 1) by the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), was to study present distributions of anthropogenic radionuclides as a part of the joint Japan – IAEA/MEL project on the Southern Hemisphere Ocean Tracer Study (SHOTS). The main objectives of the project carried out mainly by the Meteorological Research Institute (MRI) and IAEA-MEL, in collaboration with several Japanese and other oceanographic laboratories, are to study water and heat transport from the equatorial regions to the Antarctic Ocean, a programme of relevance to global climate change studies. The project will concentrate on analysis of radionuclides in water samples for a better understanding of circulation and water column processes, and for studying the distribution of radioactive and stable isotopes, as well as other non-radioactive tracers in the Southern Ocean, which plays a dominant role in the earth's climate. A post-cruise meeting was organised in May 2004 by MRI in Tsukuba, where the main objectives of the project were summarized and plans for analyses of several hundreds of samples were developed. Seawater sampling was accomplished at 93 surface and 57 water column stations with 789 water layers. Measurements of oceanographic parameters, general chemical analyses, and analyses of nutrients and CFCs were carried out onboard.



Preliminary Results

The co-analysis of nutrients, O_2 and CFCs with radionuclides offers the unique opportunity to determine the *in situ* biogeochemical dynamics of anthrogenic radionuclides in the ocean. Preliminary data on nutrients and oceanographic parameters suggest that changes in the water column and water circulation have been occuring during recent decades in the Southern Pacific Ocean, which could be of relevance to global climate change studies.

Contributed by Dr. M. Aoyama, Meteorological Research Institute, Tsukuba, 305-0052 Japan; maoyama@mri-jma.go.jp.

This article represents a personal view and does not necessarily reflect the views of MRI or the IAEA.

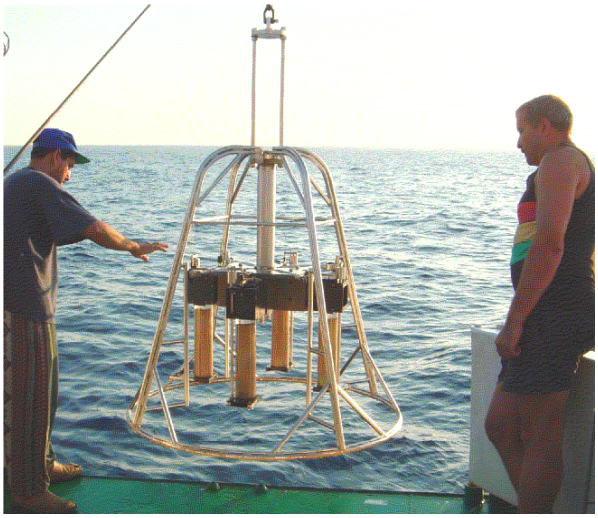
TC Project Advances Knowledge of Contamination in South Mediterranean Sea

IAEA-MEL conducted an oceanographic mission to assess marine contamination in the South Mediterranean Sea 14 – 29 June 2004. The study was carried out under the framework of the TC Project entitled, "Contamination Assessment of the South Mediterranean Sea (RAF7004)." The expedition was organized in cooperation with the Institut des Sciences de la Mer et de l'Aménagement du Littoral (ISMAL, Algeria), Commissariat à l'Energie Atomique (COMENA, Algeria), Centre National des Sciences et Technologies Nucléaires (CNSTN, Tunisia), Centre International des Techniques de l'Environnement de Tunis (CITET, Tunisia), Institut National de Sciences et Techniques Marines (INSTM, Tunisia), Ministère de la Santé Publique, and Centre National de Radioprotection (CNRP, Tunisia).

Project Objectives

The objectives of the project are to establish an integrated Marine Information System for the South Mediterranean Sea, and to develop a regional capability in North African countries so that all countries concerned can contribute to this system. This system will assess radioactive and non-radioactive contamination of the South Mediterranean Sea, using nuclear and isotopic techniques to understand water and sediment dynamics and the behaviour of contaminants. Intended outcomes include the synthesis of heavy metal, organic compound, and radionuclide contaminant data, a better understanding of the processes in the water column affecting primary productivity in the sea and its potential impact on fisheries, an estimation of spatial and temporal trends in marine contamination, and the development of computer models to investigate dispersion of contaminants.

Sampling Mission



Sediment sampling using a multicorer

The sampling work in the South Mediterranean Sea was carried out at 4 stations from Tunisia to Sicily. Seawater samples were collected at several depths using large volume water samplers (Gerard Bottle type) for radionuclides. Sequential pre-concentration of radionuclides (^{238}Pu, ^{239,240}Pu, ^{241}Am, ^{137}Cs and ^{90}Sr) was conducted onboard. Additionally, nutrient concentrations were profiled. Sediment samples were collected using multicorer sediment samplers. The cores were sectioned at high resolution for the onboard analysis of radioactive and non-radioactive contaminants. Biota samples (zooplankton) were also collected, and temperature, salinity, conductivity and dissolved oxygen were determined using CTD.

Meeting in Tunis

During the cruise (June 21-23), a meeting was held at the Centre National des Sciences et Technologies Nucléaires (CNSTN) in Ariana, Tunisia. The overall objective of the meeting was to discuss regional and national work plans of the project, in particular, a) to review the present status in the assessment of contamination in the South Mediterranean Sea, analytical capabilities of Member States, quality assurance (QA/QC) of the data, development of a regional marine information system, etc. b) to identify major technical problems to be solved for successful implementation of the project, and c) to develop plans for implementation of the project, including joint regional activities. The meeting was attended by national project coordinators from Algeria and Tunisia, the representatives of the IAEA, and 10 national participants.

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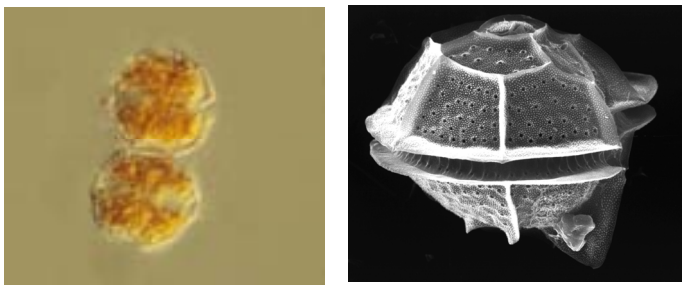
MEL and Harmful Algal Blooms: nuclear methods serving seafood toxicity management

One of the most serious, visible and increasing problems facing coastal waters is related to the phenomena commonly known as red tides, and now called Harmful Algal Blooms (HABs). HABs lead to the entry of toxic substances into the human food chain through consumption of contaminated shellfish. Paralytic Shellfish Poisoning (PSP) has the most significant impact on human health. Regulation usually takes three forms: closure of commercial fisheries, warnings to subsistence harvesters and prohibitions on commercial trade in shellfish products. The Mouse Bioassay (MBA) is the certified method of assessment for this purpose. While it is simple, rugged and reliable, the method is expensive, slow, insensitive and not bioethical. A key application of nuclear technologies that can circumvent the problems highlighted for the Mouse Bioassay is the receptor binding assay (RBA) based on the use of a radiolabelled PSP toxin. It is a rapid, sensitive and high throughput technique that can complement or be an alternative to the live Mouse Bioassay. MEL is currently providing technical support to two national, two regional and an inter-regional Technical Cooperation project to transfer this method to eleven Member States.

The important role of the US FDA in IAEA HABs activities

The US Food and Drug Administration (FDA) is strongly committed to implementing and strengthening programs to ensure the safety of seafood that may become contaminated with natural toxins from HABs, such as PSP. FDA scientists are therefore working closely with IAEA and the US National Ocean and Atmospheric Administration (NOAA) to refine and implement the RBA as an alternative to the mouse bioassay currently used for detecting PSP. One major focus of FDA effort has been to ensure the availability of the radiolabelled toxin needed for the RBA. The supply of exchange-tritiated saxitoxin has already been re-established and alternative radiolabelled toxins that avoid the limitations of the tritiated material are being developed. Concurrently, as part of its research into the origin and nature of seafood toxins and their movement through food webs, the FDA has produced PSP toxins highly enriched (>90%) in ^{13}C and in ^{15}N, and they are now exploring the possibility of detecting these labelled materials in tissue samples in collaboration with MEL. *–Contributed by Sherwood Hall, US FDA*



HABs algae Alexandrium sp *(left) and* Pyrodinium bahamense *(right)*

Future Radiotracer Applications in HABs Science at MEL

There are still important gaps in our knowledge of the ways in which seafoods become contaminated by HABs toxins. Improvements in our understanding will support better management of these economically valuable national and export industries. MEL will be addressing some of these requirements for knowledge through the applications of radio-and isotopic-labelled HABs toxins in our state-of-the-art experimental aquaria. These nuclear techniques will be used to measure the absorption of biotoxins by molluscan shellfish directly from the aquatic medium, their subsequent tissue distributions, and how they may pass up the food chain to fish and crustacean predators that can also be consumed by humans. To further link this scientific information to decision-making in fisheries management, a Coordinated Research Programme is planned by MEL for 2006 in collaboration with the IAEA/FAO. Its general objective is to integrate studies on applications of nuclear techniques to HABs bioaccumulation in mollusks and food chain transfer with risk management decision-making, in relation to suitability for human consumption. One of its envisaged outcomes will be a better valuation of the economic contribution that these nuclear technologies make to enhancing seafood safety, and consequently national and international trade in these valuable commodities.

For further information please contact F.Boisson@iaea.org (Technical Officer), R.Jeffree@iaea.org (Coordinated Reseach Project) or Sherwood.Hall@cfsan.fda.gov (US FDA).

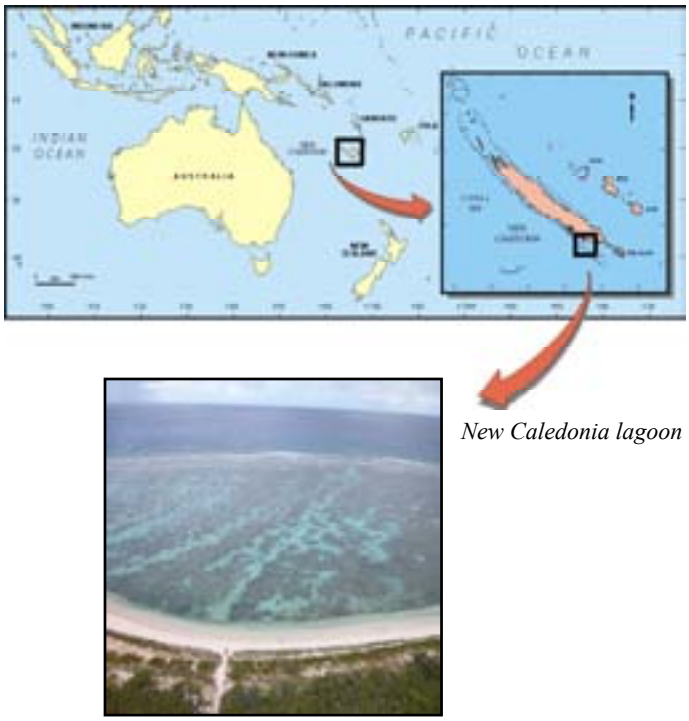
Student Pioneering e-Radioecology @ New Caledonia

by Laetitia Hédouin, PhD student

My PhD thesis on marine contamination in tropical ecosystems couples laboratory and field investigations. Sometimes field work implies working very far from your host Laboratory, which is not always easy to manage for a young student needing to stay in communication with a supervisor. I am particularly concerned with this aspect, since my field location is the lagoon of New Caledonia – 18,000 km away from Monaco! This lagoon is one of the largest in the world, and is subjected to large inputs of heavy metals due to intense land-based mining activities. The development of coastal zone management programmes relies on pollution information, yet very little is known about the environmental status of this ecosystem.

The Research

Local candidate bioindicator species were selected (bivalves and algae), and radiotracer experiments were conducted at MEL under controlled laboratory conditions to determine how these organisms accumulate metals from seawater, sediment and food. To complete and validate laboratory-derived results, field experiments were developed in New Caledonia to determine how natural populations of bivalves and algae take up and release metals under real, environmental conditions. To this end, I spent four months in New Caledonia, at the IRD-Noumea Center (French Research Institute for Development). My work focused on transplantation experiments in the field: organisms from a contaminated site are transplanted to a non-contaminated site and vice versa. Organisms were caged and maintained for 3 months in the field. Sampling was performed by scuba diving two to four times per week. While I used to dive for fun, working underwater is a completely different but very interesting experience!



New Caledonia lagoon

Challenges

At the beginning, we were faced with some difficulties. The IRD Center is permitted to work with radiotracers, but is not equipped with nuclear technical facilities devoted to routine work with large seawater volumes. Fortunately these problems were rapidly solved thanks to the help of the IRD staff and my MEL supervisor, Michel Warnau, who spent two weeks at Noumea at the beginning of my stay. When the working environment was perfectly optimized for the safe handling of radiotracers, the experiments were launched. After that, everything ran very well.

Working so far from Monaco was a bit strange at first, because I was far from my home country and from the research team with which I was used to working. At the same time, thanks to the Internet, these problems no longer exist … even if the communications are inevitably delayed due to the 9-hour time difference between New Caledonia and Europe. E-communications provided the guidance I needed: after my supervisor returned to Monaco, all decisions concerning my work continued to be taken in e-agreement with him (a lot of e-mails were regularly exchanged) and we could discuss easily any questions I had, as well as any scientific or logistic problems I encountered. Mixing radioecology, e-work, different laboratory environments and field work is an exciting, formative and mind opening adventure. I'm so happy to prepare my PhD in such a context and I sincerely wish to thank IAEA, MEL, the REL research team, and IRD for giving me this opportunity.

Pollution Survey to Guide Wreck Salvage in Gulf Waters

MEL's Marine Environment Studies Laboratory recently collaborated with the United Nations Development Programme, the Regional Organisation for the Protection of the Marine Environment and the Department for International Development (DFID UK) on a survey of shipwrecks in Kuwait and Iraq waters (Figure 1). Divers collected 198 sediments samples in the vicinity of 35 wrecks, together with 5 mid-channels sites. The samples were partially processed onboard the survey vessel, *Halul 32,* and shipped to Monaco for chemical analyses. Several metals and uranium isotopes (235, 238) were determined in all samples. Also, all samples were screened for total petroleum hydrocarbons (TPH), expressed as both chrysene and ROPME oil equivalents. A set of 24 samples was further subjected to detailed chemical analyses of petroleum hydrocarbons and chlorinated compounds, including PCBs and several pesticides.

Pollutant concentrations were compared to North American sediment quality criteria in the absence of local standards. Cadmium and mercury concentrations are generally low. This is also true for lead, except for one sample collected inside a wreck. For arsenic, copper and zinc, sporadic samples exceeded the sediment quality guideline values, but represented no pollution threat when considering the average metal content in the sediments around these wreck sites. Both chromium and nickel exhibited consistently high concentrations, interpreted to be due to the mineralogy of the suspended sediment in the river. The uranium concentrations were consistent with the crustal abundance and ^{235}U:^{238}U ratios also reflected a natural source for this element.

As indicated in Figure 2, the wrecks with the highest TPH content in adjacent sediments were W9b (*11 Ardar*), W18 (dredger), W22 (navy tug 2), W24 (fuel barges 1, 2, 3), and W27 (small tug 01), together with the mid channel sample BG03-9. Of these sites, the most contaminated location was W22, the navy tug with concentrations up to 386 and 2930 $\mu g\ g^{-1}$ for chrysene and ROPME oil equivalents, respectively, which represents an extremely contaminated site.

Figure 1: Survey vessel Halul 32 *beside the* Ain Zalah *in the shipping channel leading to Umm Qasr, Iraq (Photograph by SJ de Mora)*

Based on 24 sediment samples, the distribution for Σ PAHs differed to that of total oil. Two samples (W01-2 and W30-9) had concentrations that exceeded North American guideline value and must be classified as contaminated. Notably, these sites were not remarkable in terms of total oil contamination. With respect to organochlorinated compounds, there was no evidence of pollution in the 24 samples that were analysed. The concentrations were generally low for both a wide range of chlorinated pesticides and several PCB congeners. Total levels of DDTs and PCBs, together with the Aroclor 1254 mixture, did not surpass North American sediment quality guideline values.

For further information, please contact S.deMora@iaea.org

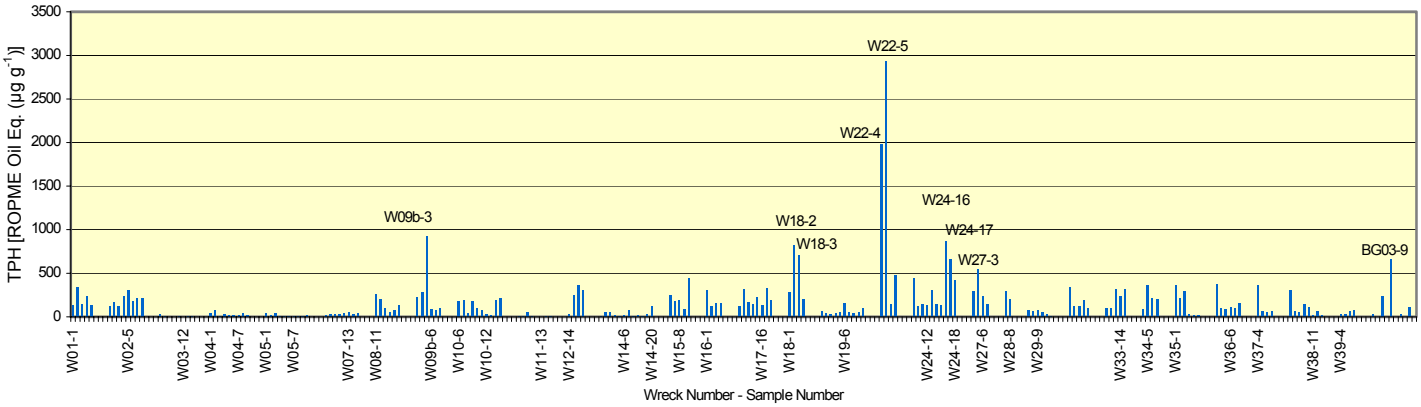


Figure 2 Oil contamination near shipwrecks in Iraq and Kuwait.

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. Applications should be made up to six months in advance through Governmental offical channels. Some recent courses and those planned for 2004 are listed below.

HOST/LOCATION	COURSE TITLE	DATE
Department of Environment, Tehran, IRAN	ROPME-sponsored course for the analysis of metals in the marine environment	February 2004
Presidency of Meteorology and Environment, Dhahran, Kingdom of Saudi Arabia	ROPME-sponsored courses (2) for the analysis of metals and the analysis of organic contaminants in the marine environment	March 2004
MEL Monaco	MEDPOL-sponsored course for the analysis of organic contaminants in the marine environment	June 2004
MEL Monaco	PERSGA-sponsored course for Designing and Implementing a Regional Monitoring Programme for Marine Pollution	September 2004
INDICASAT, Panama City, PANAMA	TC-sponsored training course on the analysis of petroleum hydrocarbons in the marine environment	September 2004
MEL Monaco	MEDPOL-sponsored course for the analysis of metals in the marine environment	Sep-Oct 2004
Centre National des Sciences et Technologies Nucléaires, Tunis, TUNISIA	IAEA-TC- sponsored course on Modelling Marine Radiotracers	October 2004

Current Intercomparison Exercises

MEL has a long experience in running programmes of intercomparison (IC) exercises and proficiency tests for the analysis of radionuclides, organic contaminants and metals in various marine media. IC exercises allow laboratories to evaluate their performance and improve the quality of their data. 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 on the order of 10 participants. Intercomparison materials are distributed free of charge to participating laboratories. MEL is also one of the few producers of marine reference materials in the world.

For further information, please contact S.Henry@iaea.org.

SAMPLE	MATRIX	STATUS
IAEA-385	Radionuclides in Irish Sea sediment	Report issued July 2004
IAEA-410	Radionuclides in Bikini Atoll sediment	To be distributed in 2005
IAEA-412	Radionuclides in Pacific Ocean sediment	To be distributed in 2006
IAEA-414	Radionuclides in Irish and North Seas fish	Report in print
IAEA-415	Radionuclides in North Atlantic fish	Sample distributed in 2004
IAEA-418	Iodine-129 in Mediterranean seawater	Data under evaluation
IAEA-432	Petroleum hydrocarbons and organochlorinated compounds in mussels	Report issued July 2004
IAEA-433	Trace elements and methylmercury in marine sediment	Report issued July 2004
IAEA-435	Petroleum hydrocarbons and organochlorinated compounds in tuna	To be distributed Oct 2004
IAEA-436	Trace elements and methylmercury in tuna	To be distributed Sep 2004

International Conference on Isotopes in Environmental Studies – AQUATIC FORUM 2004

Monte-Carlo, Monaco, 25-29 October 2004

Organized by the
International Atomic Energy Agency (IAEA)

Co-sponsored by the
Abdus Salam International Center For Theoretical Physics (ICTP)
International Hydrological Programme (IHP) of UNESCO
Intergovernmental Oceanographic Commission (IOC) of UNESCO
Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée (CIESM)

Hosted by the
Principality of Monaco
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Invited speakers

P. K. Aggarwal:	Recent trends in isotopic hydrological studies
D. Allemand:	Use of coral skeleton as environmental archives: the biological basis
M. Aoyama:	Southern Hemisphere Ocean Tracer Study (SHOTS)
M. Betti:	From bulk to particle analysis – a new challenge for radioecology
W.C. Burnett:	Measurement and potential importance of submarine groundwater discharge
E. Druffel:	Radiocarbon in corals as a tracer of past climate changes
R. Dunbar:	Isotopic studies of the ENSO phenomena
A.J.T. Jull:	Applications of accelerator mass spectrometry to environmental and paleoclimate studies
C. Kendall:	Tracing sources of organic matter and nitrate in the San Francisco Bay-Delta-River ecosystem
P. Kershaw:	Recent trends in marine radioecology
R.M. Key:	Bomb-radiocarbon: distribution, inventory, and change
W.E. Kieser:	New directions for accelerator mass spectrometry technology
G. Korschinek:	^{53}Mn in ferromanganese encrustations
W. Kutschera:	Reading the isotope language
R. Michel:	Use of tritium time series to estimate physical parameters of hydrologic systems
N.J.P. Owens:	The use of ^{15}N in unravelling the marine nitrogen cycle
J. Readman:	Isotope markers in the marine environment
P. Schlosser:	Tritium in the Southern Ocean – WOCE results
F. Schwartz:	Opportunities and challenges in research on ground water modelling

for further information contact : http://www-pub.iaea.org/MTCD/meetings/meetings.asp
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