Environment

Objective

To enhance the capacity to understand marine, terrestrial and atmospheric environmental processes and identify problems caused by radioactive and non-radioactive pollutants and climate change using nuclear techniques and isotopes.

Pollutants in the Environment

Nuclear technologies are increasingly being used to monitor and to protect the environment. In 2013, the Agency, through the IAEA Environment Laboratories, finalized work on two analytical methods to assist laboratories in accurately measuring organic mercury and petroleum hydrocarbons in marine biota in the Mediterranean Sea, in the framework of the UNEP Mediterranean Action Plan's Programme for the Assessment and Control of Pollution in the Mediterranean Region (MED POL). Quality assured data on hazardous contaminants in marine samples are essential for accurately assessing pollution status and trends in the coastal marine environment to prepare action plans and measures to protect the Mediterranean Sea and ensure the sustainable delivery of ecosystem services.

Work continued on two projects supported by the Peaceful Uses Initiative, one on applications of isotopic measurements for determination of long lived radionuclides in the marine environment and the other on implementation of a comprehensive sampling and analytical methodology to determine and trace oil pollution in marine waters. The projects resulted in two publications in 2013: *Measurement and Calculation of Radon Releases from NORM Residues* (Technical Reports Series No. 474), on naturally occurring uranium and thorium; and a special issue of the *Journal of Environmental Radioactivity* on environmental remediation. The Agency also contributed to a report by the United Nations Secretary-General to the United Nations General Assembly (GA resolution A/RES/68/99) on remediation of areas affected by the Chernobyl accident.

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The Agency is working with Japan to monitor the environmental impact of radioactive discharges from the affected reactors at the Fukushima Daiichi nuclear power plant. At Japan's request, and on the basis of an agreement between the Japanese Government and the Director General, the Agency sent experts to review the Japanese marine monitoring programme and procedures, and provided advice in relation to enhancing the quality of the measurements (Fig. 1). The experts' assessment confirmed the quality and credibility of the monitoring process. Fukushima University requested an Agency mission to provide advice on forest management in affected areas, and Agency staff lectured at the University

FIG. 1. Marine monitoring activities near the Fukushima Daiichi nuclear power plant.

of Tsukuba on monitoring programmes in contaminated forests and on the application of dynamic models for long term predictions of radionuclide behaviour.

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Ecosystem Processes

The oceans play an essential role in regulating and buffering the Earth's climate through exchanges with the atmosphere. For example, about 25% of the carbon dioxide released by fossil fuels is absorbed by the oceans. A small fraction is transformed by marine phytoplankton into carbon rich particles that sink to depth and either feed deep ocean life or settle on the ocean floor. The Agency, through the IAEA Environment Laboratories in Monaco, is using natural radioisotopes to study these processes in sensitive environments such as upwelling regions and the Arctic Ocean. An international collaborative effort between the Agency and two German research institutes — the GEOMAR Helmholtz Centre for Ocean Research Kiel and the University of Kiel — that began in 2013 is aimed at better understanding tropical oceans and the carbon sedimentation and sequestration processes in low oxygen zones such as the Peruvian upwelling system. Initial results from field sampling and radioanalytical measurements were presented in October at the Latin American Congress of Marine Sciences. The results highlight the important carbon export in this highly productive region.

FIG. 2. An exhibit of the IAEA Environment Laboratories at the Scientific Forum 2013 at the 57th regular session of the General Conference.

Dissolved carbon dioxide also has the effect of increasing seawater acidity, a phenomenon known as ocean acidification (OA). OA has emerged as an issue of global concern, and a number of Agency activities are addressing the need for robust scientific information to support adaptive measures. These include: support for the Agency's Ocean Acidification International Coordination Centre (OA-ICC); a CRP on the socioeconomic impacts of OA; international workshops on the economic impacts of OA; laboratory experiments on the biological and ecological effects of OA; and specialist training in experimental radioisotope techniques.

In 2013, two Member States — Namibia and Peru — joined the CRP on Ocean Acidification and the Economic Impact on Fisheries and Coastal Society. Areas of research in the CRP include: investigation of shellfish and coral calcification using calcium-45; monitoring of pH and carbonate in coastal waters and aquaculture facilities; investigation of past ocean pH using palaeogeology; and bio-economic modelling of fisheries. The CRP aims at promoting awareness of food security, ecosystem services and livelihoods impacted by OA, and at fostering centres of knowledge in developing countries and in regions of anticipated sensitivity.

The OA-ICC is supporting biennial, multidisciplinary workshops to discuss the gap between OA impacts on ecosystem services and the associated economic costs. It has contributed to several publications, including a multilingual factsheet entitled *20 Facts about Ocean Acidification*[1]. The Agency highlighted its work on OA and the OA-ICC through outreach activities at the Scientific Forum during the 57th regular session of the Agency's General Conference in 2013 (Fig. 2), the 14th Meeting of the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea (UNICPOLOS), and the 19th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP19).

Strengthening Laboratory Analyses in Member States

To assist Member States in enhancing the reliability of environmental data and to support their monitoring and research programmes, the Agency provides a range of reference materials for analysis of radionuclides, stable isotopes, trace elements and organic pollutants. Six new reference materials were prepared in 2013: two for radionuclide analysis in seaweed and soil, two for trace element analysis in algae and marine sediment, and two for organic contaminants in marine sediment and biota.

[1] Available at: *http://www.iaea.org/ocean-acidification/download/OA20Facts_Nov.pdf*.

The Agency also organizes annual proficiency tests that enable laboratories worldwide to evaluate their analytical performance. In 2013, the Agency collaborated with the UNEP Mediterranean Action Plan to test 32 laboratories in 11 Mediterranean countries on the determination of organic contaminants and trace elements in marine samples. Other activities included a proficiency test involving 31 laboratories in 24 countries that analysed seawater for strontium-90, caesium-134 and caesium-137. At the request of Japan, the analytical performance of 45 Japanese laboratories was also compared.

As part of the Agency's quality assurance strategy, the Analytical Laboratories for the Measurement of Environmental Radioactivity (ALMERA), in cooperation with the Agency's Incident and Emergency Centre (IEC), formally registered ten member laboratories as national capabilities in the Agency's Response and Assistance Network (RANET) for radiological environmental emergencies. Several RANET laboratories registered for the current ALMERA proficiency test and received the samples for analysis in November 2013. In parallel, 60 ALMERA laboratories reported back analytical results from the 2013 proficiency test within 72 hours, as part of a training exercise for emergency preparedness.

Capacity Building in Member States

The Agency provides technical support to Member States through training courses and national, regional and interregional technical cooperation projects, and through preparation of methodologies and manuals. For example, scientists from Bosnia and Herzegovina, Cyprus, Egypt, Israel, Libya, Montenegro, Oman, Tunisia and Turkey were trained at the IAEA Environment Laboratories in analytical techniques for determining trace elements and organic contaminants in marine biota, and 34 participants from 30 European countries were trained in soil sampling methodologies (Fig. 3).

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An Agency technical cooperation project to upgrade the National Nuclear Analytical Laboratory in Qatar provided training to local staff in environmental monitoring of the naturally occurring radionuclides industry. The training is aimed at enabling staff to assess the environmental impacts of the industry and the potential effects on human health in the region. Another technical cooperation project provided sampling equipment for the small island developing States in the Asia–Pacific region (Cook Islands, Fiji, Kiribati, Marshall Islands, Palau and the Solomon Islands) to assess the potential impact of discharges to the ocean from the Fukushima Daiichi nuclear power plant. The samples collected as part of the project were sent to the IAEA Environment Laboratories in Monaco for analysis.

FIG. 3. Training in soil sampling techniques for environmental radionuclide analysis.

Member States are continuing their efforts to mitigate and manage harmful algal blooms (HABs) to improve seafood safety. The radioligand receptor binding assay (RBA) methodology, developed by the US National Oceanic and Atmospheric Administration in collaboration with the Agency, is a cost effective and sensitive means of detecting HABs that is already in use in several Member States in the Africa, Asia–Pacific and Latin America regions. In response to continued increases in Member State interest in RBA, the Agency has expanded its activities to meet the challenges of this important environmental problem. In 2013, the RBA methodology was made operational at the IAEA Environment Laboratories and the Agency published *Detection of Harmful Algal Toxins Using the Radioligand Receptor Binding Assay: A Manual of Methods* (IAEA-TECDOC-1729). Both will improve training support to Member States in the field of HAB management and seafood safety.