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IAEA's ALMERA network: Supporting the quality of environmental radioactivity measurements

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HIGHLIGHTS

- ALMERA is a network aiming for excellence in environmental radioactivity measurement.
- The IAEA organizes annual proficiency tests for the network for environmental and food samples.
- The PT system is designed to test rapid response and accuracy and precision of measurement results.
- Increased performance of ALMERA labs is backed by a "PT - method development – training – PT" strategy.

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ABSTRACT

The International Atomic Energy Agency coordinates and provides methodological and analytical quality support to the network of Analytical Laboratories for the Measurement of Environmental Radioactivity (ALMERA), comprising 150 laboratories in 84 countries. Annual proficiency tests (PTs) are organized for the network laboratories using sets of different samples typically encountered in environmental and food monitoring laboratories. The PT system is designed to respond to the needs of the network for rapid response and reliable measurement results, and to metrological principles and international standards and guides. Comparison of performance of ALMERA and non-ALMERA laboratories in PTs indicates that the "PT – method development – training – PT" strategy adopted for capability building is beneficial to the network.

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1. Introduction

ALMERA is a network of Analytical Laboratories for the Measurement of Environmental Radioactivity, established in 1995 and coordinated by the International Atomic Energy Agency (IAEA). The network aims to enhance the capability and performance of participating laboratories with a view, inter alia, to providing timely and reliable measurement results in emergency situations. With 150 member laboratories in 84 countries at the end of 2014, the network is structured in five regional groups: Africa, Asia Pacific, Europe, Middle East and North and Latin America, each having a regional coordinating laboratory appointed for periods of 5 years. The general coordination is facilitated by the Environment Laboratories of the IAEA, in the framework of the Environment Programme in the area dedicated to Reference Products for Science and Trade. This programmatic area covers the support to IAEA Member States' laboratories for development of analytical techniques, improved quality management, capacity building and network activities. It includes the development of recommended analytical methods, the production of reference materials and the organisation of proficiency tests.

The aim of this paper is to introduce ALMERA and to describe the current status and plans for development in the various areas of activity, particularly in the area of proficiency tests and training.

2. Network activities

The IAEA supports the ALMERA network by organizing annual coordination and planning meetings, by leading the development and validation of methods for sample collection and analysis and by organizing training courses and workshops. A key activity is the organisation by the IAEA of at least one interlaboratory comparison (ILC) exercise and/or proficiency test (PT) every year, as a tool for external quality control for laboratories in Member States.

The strategic approach to improving analytical performance

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among member laboratories is based on the coordinated provision of PTs, method development and training. The extensive database of proficiency test results allows an assessment of the analytical difficulties encountered by the laboratories and methodological developments are oriented to target the problems. Practical training is then organised, dedicated to familiarizing the laboratories with the upgraded or new methods. During annual coordination meetings, representatives of member laboratories meet in regional working groups and discuss priorities for PT matrices and radionuclides, method development, training and communication. The regional priorities are then synthesized by thematic working groups and finally a general work plan for the following year is agreed, taking into account the availability of resources. Typically the work plan includes an annual PT, one to two training courses and/or workshops per year and the collaborative development and validation of one to two analytical methods about every 3 years. These activities provide a mechanism for laboratories to document and improve their analytical performance and allow ALMERA to maintain a pool of expertise applied in environmental monitoring, in emergency preparedness and response, in radiotracer applications to environmental, climate and pollution studies, in method development and validation and in capacity building.

After the accident at the Fukushima Dai-Ichi Nuclear Power Plant (NPP) in March 2011, the interest in improving rapid response capabilities increased considerably among network member laboratories. In response, the IAEA organised specific training, method development and proficiency testing (Tables 1 and 2).

Custom-developed training is a central element for ALMERA, and responds to increased metrological requirements met by member laboratories, to various methodological aspects of interest for these laboratories, to requirements for rapid assessment methods, etc. The list of past and up-coming training courses and workshops organised and/or hosted by the IAEA Environment Laboratories in collaboration with other laboratories (Table 1), illustrates the main requirements of the network for capacity building. Future priority areas identified for courses and workshops include, amongst others, naturally occurring radioactive material (NORM) samples from the oil industry, organically-bound tritium (OBT) and tritium in water, advanced laboratory-based and in-situ gamma-ray spectrometry, laboratory QA/QC for accreditation, preparation of high accuracy reference materials and calibration standards for gamma-ray spectrometry, harmonization of gross alpha and beta measurements.

Analytical method development and validation, followed by the publication of the validated method in the IAEA Analytical Quality in Nuclear Applications Series (https://nucleus.iaea.org/rpst/referenceproducts/almera/Validated_analytical_methods/index.htm),

Table 1
ALMERA training courses and/or workshops.

Year	Title of the workshop/training course
2007	Understanding and evaluating radioanalytical measurement uncertainty
2009	Uptake of radionuclides into staple crops in the Asian region
2009	In-situ X-ray fluorescence and gamma ray spectrometry
2010	Coincidence summing and geometry corrections in gamma spectrometry
2011	Measurement of natural radionuclides in environmental samples and NORMs and TENORMs by gamma spectrometry: experimental challenges and methodologies
2012	Alpha spectrometry and radioanalytical techniques
2012	Measurement results uncertainty and method validation
2014	Rapid assessment methods for environmental radioactivity
2014	Rapid determination of radiostrontium in milk
2015	Rapid assessment methods for environmental radioactivity
2015	In-situ gamma-ray spectrometry

Table 2
ALMERA PTs and interlaboratory comparisons

Year	Proficiency Test/Interlaboratory comparison
2005	Determination of Sr-90, alpha and gamma emitters in environmental samples
2005	Soil sampling interlaboratory comparison
2006	Gamma emitting radionuclides in water, soil and grass
2007	Artificial and natural radionuclides in water, soil and spinach
2007	Po-210 determination in water
2008	Naturally occurring radionuclides in phosphogypsum
2009	Gamma emitting radionuclides in simulated air filters
2010	Ra-226 in soil and natural radionuclides in water
2011	Natural and artificial radionuclides in soil and water
2012	Natural and artificial radionuclides in water, hay and soil
2013	Man-made and natural radionuclides in water and flour samples
2014	Anthropogenic radionuclides in water, seaweed and sediment sample
2014	Gamma-ray spectra evaluation exercise
2015	Anthropogenic and natural radionuclides in water, biota and soil samples

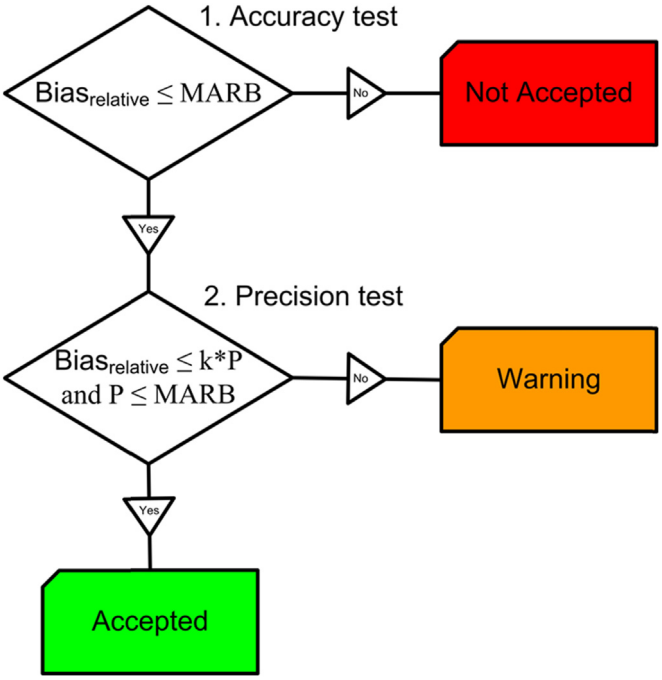

Fig. 1. The evaluation of PT results includes accuracy and precision tests. Quantities appearing in the diagram are explained in the text (paragraph 3). Color coding: "accepted" – green; "warning" – yellow and "not accepted" – red.

relies on a collaborative effort of network laboratories. Methods for routine and emergency monitoring were developed according to a protocol involving a literature survey, selection, testing and validation by groups of laboratories. These include methods for the analysis of natural and anthropogenic radionuclides in environmental (aerosol, soil/sediment, freshwater), food (milk) and technogenic (phosphogypsum) samples (IAEA, 2009a, 2009b, 2013, 2014a, 2014b, 2014c). Currently, the development of rapid methods for radiostrontium analysis in soil and seawater are underway, partly prompted by the interest for high throughput methods following the analytical burden of laboratories after the Fukushima Dai-Ichi NPP accident. The sequential determination of radionuclides in NORM samples is considered for the next development.

3. ALMERA proficiency tests

The IAEA organises dedicated PTs for ALMERA network laboratories, in addition to the PTs open to non-members (world-

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