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REIMEP-22: Interlaboratory Comparison on U Age Dating

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Nuclear forensics is a key element of nuclear security aiming at the identification and characterisation of nuclear (seized) material, such as uranium or plutonium, to re-establish the history of the nuclear material of unknown origin. By applying advanced analytical techniques, the isotopic composition, the chemical impurities and the (macro or micro) structure of the nuclear material can be determined.

More recently, the determination of the "age" of the material has been put forward [1,2]. The "age" of a nuclear material refers to its production date, i.e. the time elapsed since the last chemical separation of the daughter nuclides from the mother radionuclide (typically U and Pu). This specific signature allows one to narrow down the possible origins of the material in question and to provide valuable hints on its history.

Confidence in the integrity and quality of measurement results and services is of great importance. In order to answer the emerging need of the nuclear forensic community, the European Commission - Joint Research Centre - Institute for Reference Materials and Measurements (EC-JRC-IRMM) and the Institute for Transuranium Elements (EC-JRC-ITU) joined efforts to develop a unique uranium reference material (IRMM-1000) certified for the date of the last chemical separation. Certified reference materials, such as the new IRMM-1000 are a prerequisite for proper validation of measurement procedures when determining the "age" of uranium samples, establishing traceability to the SI of the measurement result. The IRMM-1000 units were prepared at ITU from a low-enriched uranium solution after complete separation of thorium decay products (zeroing the initial daughter nuclide concentration) at a well-known time and allowing the ingrowth of the daughter nuclides [3]. IRMM-1000 has been produced in compliance with ISO Guide 34 and will be available beginning of 2015.

Prior to the release of IRMM-1000, the EC-JRC-IRMM, in cooperation with the Nuclear Forensics International Technical Working Group (ITWG) and laboratories in the field, launched a new Regular European Inter-laboratory Measurement Evaluation Programme (REIMEP-22) based on this material, called "U Age Dating - Determination of the production date of a uranium certified test sample". REIMEP-22 participating laboratories received a 20 mg or 50 mg uranium certified test sample, depending whether they applied a mass spectrometric or radiometric technique, with an undisclosed value for the production date [4]. They were asked to analyse and report on the two parent/daughter pairs: 234U/230Th (compulsory) and 235U/231Pa (optional) to determine the "age", using their routine laboratory procedures. The challenge in REIMEP-22 was to separate 234U/230Th and optionally 235U/231Pa with a high chemical recovery in order to determine the date of the last purification of the daughter radionuclide from the parent nuclide.

The individual reported results of the participants are evaluated against the independent external certified reference value (i.e. the certified production date) with demonstrated traceability and uncertainty, as evaluated according to international guidelines. In addition participants' results are presented according to analytical approaches and instrumental techniques applied by the participants for the analysis of the REIMEP-22 samples.

IRMM-1000 and REIMEP-22 are valuable tools for assessing measurement performance, validating methods and establishing quality control in the field of nuclear forensics and nuclear security and are at the same time very beneficial for laboratories from geochemistry.

References

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