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Nuclear Smuggling Detection and Deterrence Radiochronometry: Past, Present, and Future - Review of Radiochronometry Collaborations and Challenges

Technical Summary
For nearly two decades, the U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA) has sponsored nuclear forensics collaboration between the United States and partner countries in the field of radiochronometry – the science of age dating nuclear material. This collaborative research is currently managed by the DOE/NNSA Office of Nuclear Smuggling Detection and Deterrence. Partner countries have included: Armenia, Australia, Canada, China, European Union, France, Israel, Japan, Republic of Korea, Romania, and the United Kingdom, and new projects are under development with Kazakhstan and Ukraine. The goal of these partnerships has been to advance radiochronometry capabilities throughout the global forensic community in order to support the investigation of nuclear material found out of regulatory control.

Significant contributions to the forensic community have been achieved through international collaboration and will be summarized in this presentation. These include: publication of radiochemistry and mass spectrometry methods for radiochronometry; the generation and publication of measured 230Th/234U and 231Pa/235U model ages for uranium certified reference materials; publication of consensus model ages for plutonium certified reference materials; radiometric (alpha and gamma counting) measurements of model ages; multi-instrument radiochronometry studies; and the development of new reference materials to support radiochronometric analyses.

The field of radiochronometry has evolved over time and we will summarize how international partnerships have evolved concurrently. New chronometers have been developed to support age dating (e.g. 231Pa/235U, 226Ra/230Th, 227Ac/231Pa) and discordance between new chronometers is now being used to understand how nuclides used for age dating behave during complex fuel cycle stages, such as uranium metal production and UF6 storage. Through partnership and discussions between international subject matter experts, we have identified challenges specific to radiochronometry and the uranium and plutonium production cycles. These challenges will be discussed to encourage future partnership that will support the application of radiochronometry during nuclear forensic investigations. To summarize, this presentation is a review of international collaboration in the field of radiochronometry that discusses where we came from, what we have accomplished, and addresses where we need to go.

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