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Signature research on isotopic composition and age dating

Nuclear forensics is essential in response to incidents involving nuclear and other radioactive materials out of regulatory control. Scientists are expected to apply extensive analytical tools resulting with clear and credible answers, needed by decision makers. The answers are related to a large set of practical questions, like: what is the origin of the materials found out of control, what is the route by which they arrived to the scene, can the material be attributed to a specific facility, what is the "age" of the material, and more.

Most illicit trafficking incidents of nuclear materials are related to natural or low enriched uranium [ ]. Several signatures of uranium ore concentrate, such as chemical composition, rare earth element pattern, strontium and neodymium isotope ratios, anionic impurities and others, provide information on the material's history [, , , , , , ,]. These analytical techniques are well developed and were widely adopted by the nuclear forensics community. However, more analytical tools are needed to enhance and strengthen the ability to achieve origin and route attribution.

Analysis of stable isotopes is a common, well established analytical technique, applied in many scientific fields, such as geochemistry, geology, earth science, and others. Elements such as hydrogen, carbon, nitrogen, oxygen, sulfur, bromine, chlorine and lead exhibit natural isotope variability [, , , , ,], related to geographic location and/or to the production processes. Therefore, the determination of their isotopic composition might serve as an additional significant signature, contributing to the important process of attribution.

Though being attractive to be used for attribution while conducting a nuclear forensics investigation, the implantation of stable isotopes analysis in relevant incidents, is rather small. The reasons for that will be described.

The use of various chronometers for the determination of the material's age, demands the application of chemical separation procedures, due to age shift which might occur by the presence of unwanted "daughters" in the solution. That is an important signature attracting the scientific community for ongoing improvements.

We will present recent published researches reporting on stable isotopes analysis related to nuclear forensic and model age chronometers as well.

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