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Small Volume Assay Method for 210Pb/Po in Lead

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Content

Sensitive radiation detections systems most commonly utilize refined lead to shield the detectors from background radiation. Selecting lead with the lowest intrinsic radioimpurities is important to reduce the background to levels such that the sensitivity of the detection system can be maximized. Lead shields are designed in a scaled approach such that the lead with the highest levels of radioimpurities is furthest from the detectors while the more radiopure is closest, serving as a shield to the more contaminated lead. Radioimpurities are primarily 238U and 232Th decay-chain isotopes and are present naturally in the ore from which lead is refined. The radioactive lead isotope, 210Pb (238U decay chain), becomes substantially out of secular equilibrium with its parents due to the lead refinement process. This isotope can be measured directly via gamma spectrometry, but to do so requires kilogram sample sizes and long count times. The 210Pb content can also be inferred by quantifying the alpha emissions of its daughter 210Po if the lead is sufficiently old enough to ensure that secular equilibrium has been established. In the past, antiquity lead shielding was used for low-background detectors due to the relatively short half-life of 210Pb of 22.2 years, but the availability and cost of this lead can be prohibitive. As the loss of lead smelting capacity in the U.S. has eliminated the traditional commercial supply of standard "low background" lead, a systematic approach to cleanly assay commercially available lead stock for 210Pb content is required to determine the suitability of a given lead supply for a given shielding design. One such method for assaying 210Pb concentration using small sample sizes and small volumes of ultra-high-purity reagents has been developed. The results of assaying lead from ten different lots are presented. The 210Pb concentrations ranged from ˜0.1 – 75 Bq/kg, as inferred by the 210Po alpha quantitation.

About the Presenter

Shannon M. Morley (B.S., Chemistry, University of Montana, 2003) is a research scientist at Pacific Northwest National Laboratory. Ms. Morley is an experienced radiochemist and has focused her contribution to multi-faceted projects primarily through chemical separations, alpha energy analysis, and gamma energy analysis. Additional research and programmatic activities include nuclear accident dosimetry response, Hanford Groundwater Remediation quality control support, treaty monitoring via the International Atomic Energy Agency, and nuclear non-proliferation. She has authored peer-reviewed publications, and has been actively involved in nuclear forensic education through the development of and participation in the IAEA/NNSA International Workshop on Nuclear Forensic Methodologies.

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