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Preparation and calibration of a Pa-231 reference material

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A ^{231}Pa reference material has been prepared and characterized for the amount of ^{231}Pa (Fig. 1). This reference material is primarily intended for calibration of ^{233}Pa tracers produced for ^{231}Pa - ^{235}U model age measurements associated with nuclear forensic and nuclear safeguards. Primary measurements for characterization were made by isotope dilution mass spectrometry of a ^{231}Pa stock solution using a ^{233}Pa spike. The spike was calibrated by allowing multiple aliquots of the ^{233}Pa spike solution to decay to ^{233}U and then measuring the ingrown ^{233}U by isotope dilution mass spectrometry using a certified U assay and isotopic standard as a spike (CRM 112-A). The molality of the ^{233}Pa spike and the ^{231}Pa master solution were independently verified by massic activity measurements performed at multiple National Metrology Institutes. A total of 112 units of the reference material were prepared with each unit being comprised of a 30 mL FEP Teflon bottle containing a known amount of ^{231}Pa (~1.46 10^{-10} mol) in an acid solution of 2 mol L^{-1} HNO_3 and 0.1 mol L^{-1} HF. This new reference material will simplify calibration of the ^{233}Pa isotope dilution spikes, provide metrological traceability, and potentially reduce the overall measurement uncertainty of ^{231}Pa - ^{235}U model ages determined for uranium bearing materials.

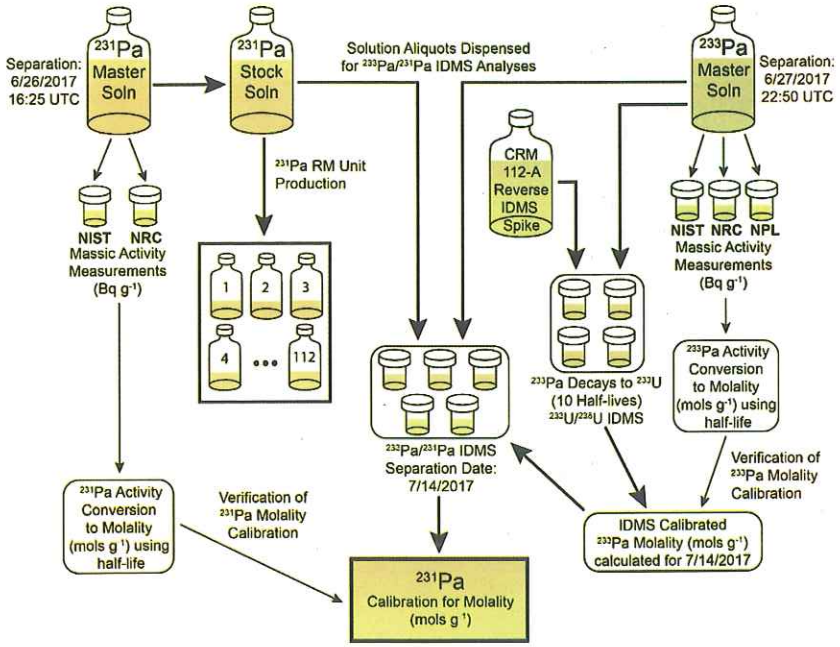

Fig. 1
Schematic of the ^{231}Pa reference material production and characterization process. The heavier arrows indicate material transfer and analyses performed for the primary calibration of the ^{231}Pa material. Lighter arrows indicate material transfer and analyses for verification measurements.