

# Rapid Determination of Pu, Np, Am and Cm in 100g Soil Samples

**Summary of Method** Pu(Np) and Am-Cm are separated and concentrated from 100-200 gram soil samples. Samples are muffled at 550°C to destroy organic content and wet ashed and leached with HNO<sub>3</sub> and HCl. The filtered leachates are evaporated to dryness and fused with NaOH in Zr crucibles. Sequential precipitations facilitate matrix removal. Actinides are separated on stacked 2mL cartridges of Eichrom TEVA, TRU, and DGA resins. Native rare earths from the samples are removed from Am-Cm using TEVA Resin and ammonium thiocyanate. Actinides are measured by alpha spectrometry following CeF<sub>3</sub> microprecipitation onto Eichrom Resolve<sup>®</sup> Filters. Chemical yields of tracers ranged from 93-98% for <sup>236</sup>Pu and 85-93% for <sup>243</sup>Am. Measured values typically agreed to within 10% of reference values. Sample preparation for batches of 12 samples can be completed by a single operator in <8 hours.

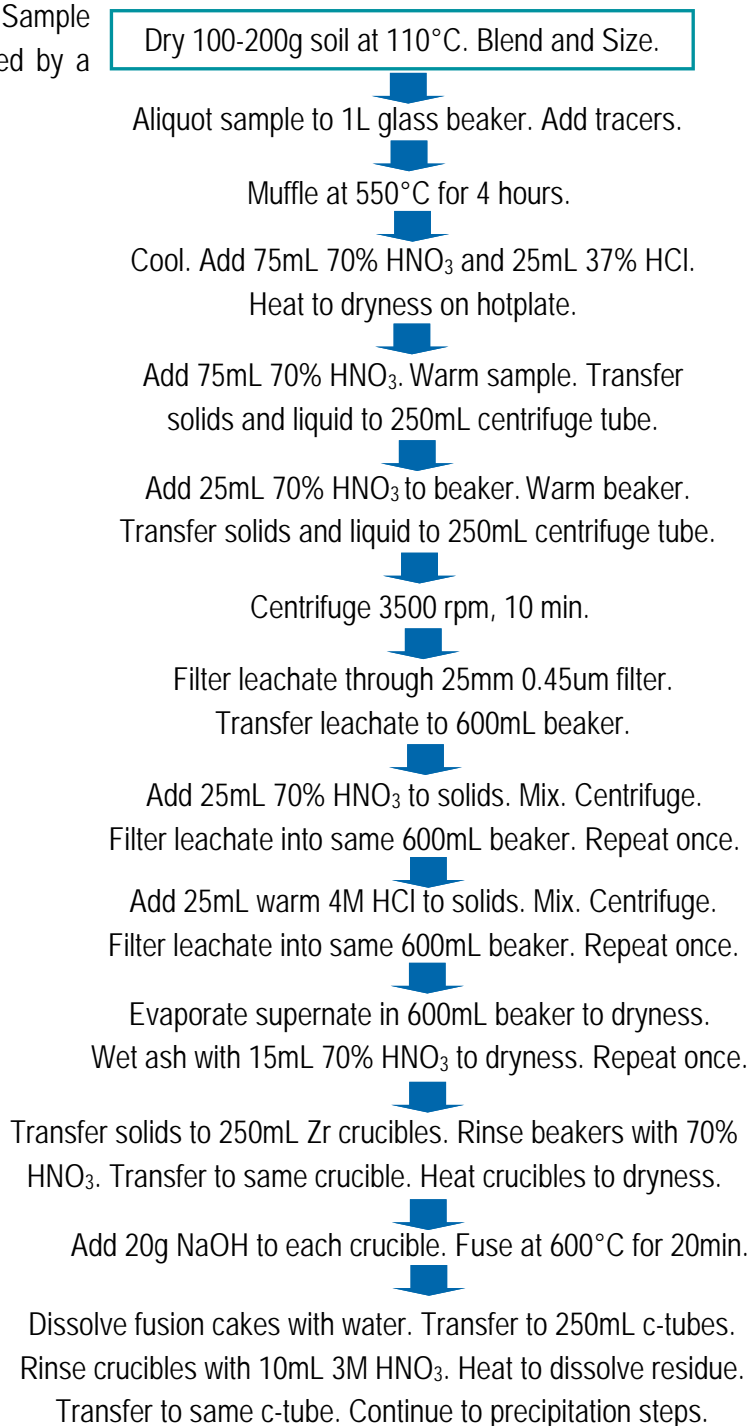
## Reagents

TEVA Resin, 2mL Cartridges (Eichrom TE-R50-S)	
TRU Resin, 2mL Cartridges (Eichrom TR-R50-S)	
DGA Resin, 2mL Cartridges (Eichrom DN-R50-S)	
Iron carrier (50mg/mL Fe, as ferric iron nitrate)	
<sup>242</sup> Pu (or <sup>236</sup> Pu if meas. Np), and <sup>243</sup> Am tracers	
La carrier (10mg/mL)	Ce carrier (1mg/mL)
Deionized Water	2M Al(NO <sub>3</sub> ) <sub>3</sub>
10% (w:w) TiCl <sub>3</sub>	HNO <sub>3</sub> (70%)
HCl (37%)	NaOH
HF (49%) or NaF	Boric acid
H <sub>2</sub> O <sub>2</sub> (30%)	NaNO <sub>2</sub>
Denatured ethanol	Sulfamic Acid
Ascorbic Acid	Ammonium Thiocyanate
Formic Acid	

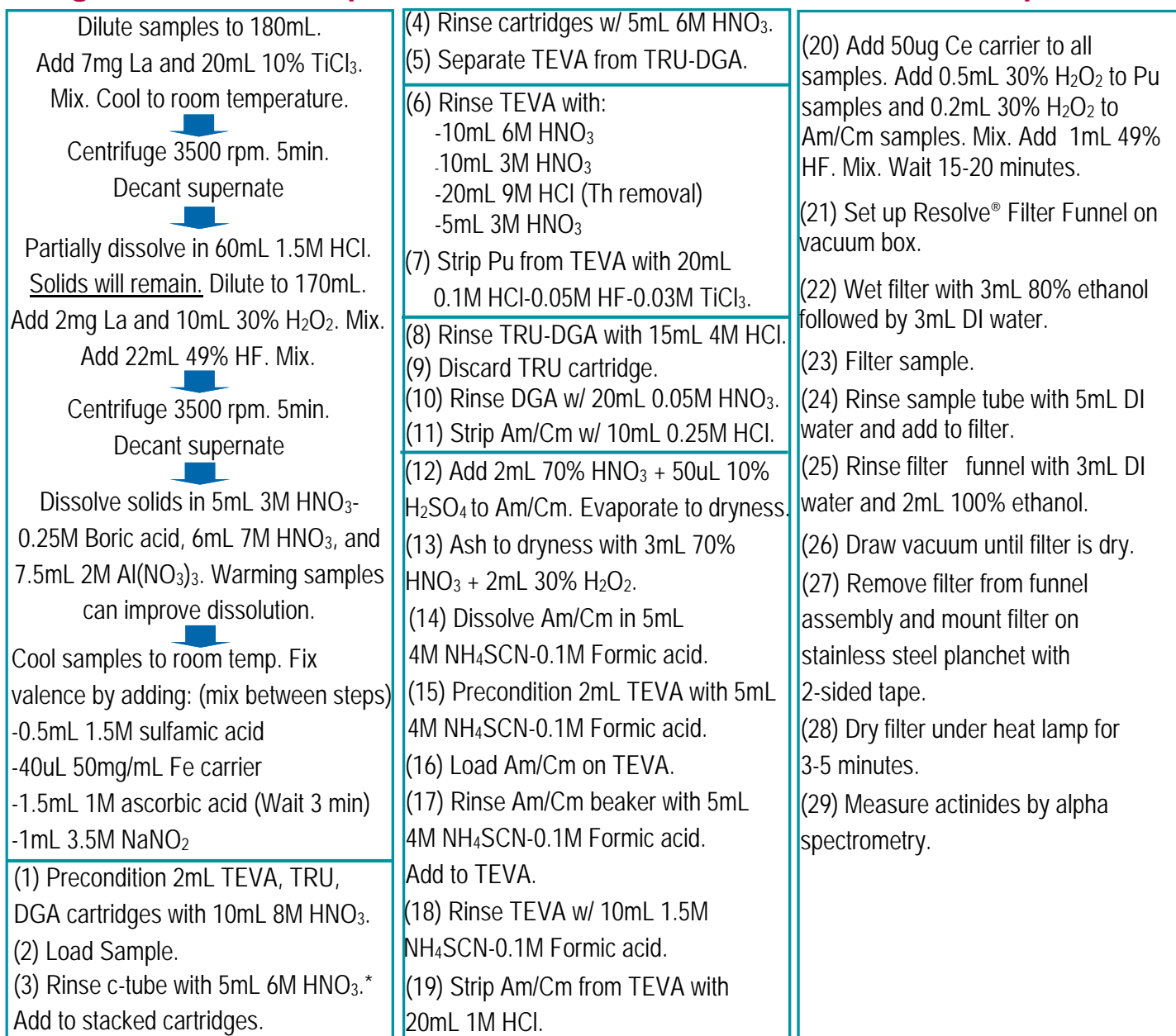
## Equipment

Vacuum Box (Eichrom AR-24-BOX or AR-12-BOX)	
Cartridge Reservoir, 20mL (Eichrom AR-200-RV20)	
Inner Support Tubes-PE (Eichrom AR-1000-TUBE-PE)	
Yellow Outer Tips (Eichrom AR-1000-OT)	
Resolve Filters in Funnel (Eichrom RF-DF25-25PP01)	
1L and 600mL Glass beakers	
250mL Zirconium crucibles with lids	
Stainless Steel Planchets with adhesive tape	
Alpha Spectrometry System	
50mL and 250mL Centrifuge Tubes	
25mm 0.45um filters	
Centrifuge	Heat Lamp
Muffle Furnace	Hot Plate
Analytical Balance	Vacuum Pump

**Figure 1. Sample Preparation**



**Figure 2. Actinide Separation on TEVA - TRU - DGA and Source Preparation**



\*Adding 50uL of 30% H<sub>2</sub>O<sub>2</sub> to tube rinse can help improve U decontamination.

		Method Performance			
		<sup>242</sup> Pu	<sup>238</sup> Pu	<sup>243</sup> Am	<sup>241</sup> Am
Sample Size (g)	Replicates	Tracer % Recovery	Measured % Bias	Tracer % Recovery	Measured % Bias
100	3	86 ± 7	-3.0	94 ± 4	-10
100	3	81 ± 15	-6.0	80 ± 5	-13
200	2	82 ± 1	2.0	93 ± 5	-19
200	3	80 ± 8	-5.0	93 ± 5	-18

**References**

1) Sherrod L. Maxwell, "Rapid method for determination of plutonium, americium, and curium in large soil samples," *J. Radioanal. Nucl. Chem.*, 275(2), 395-402 (2008).