

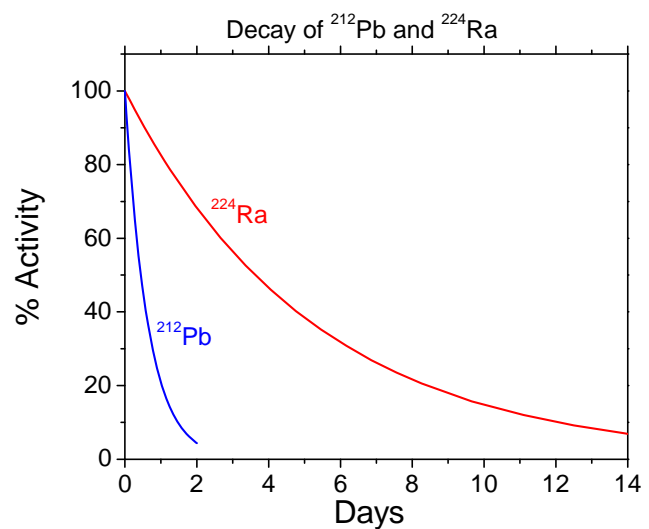
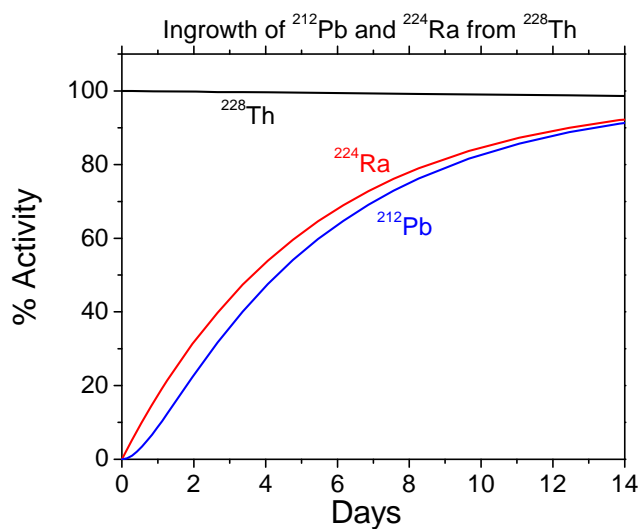
Summary of Method A method for the preparation of ^{224}Ra ($t_{1/2} = 3.62$ days) and ^{212}Pb ($t_{1/2} = 10.64$ hours) from ^{228}Th ($t_{1/2} = 1.913$ years) source material is presented. The method employs 2mL cartridges of UTEVA and Sr resins to obtain high purity ^{224}Ra and ^{212}Pb in small volumes of eluate, while preserving valuable ^{228}Th material. The source material is adjusted to 4M HNO_3 and loaded onto stacked 2mL cartridges of UTEVA and Sr resins. ^{228}Th is retained on UTEVA Resin, while ^{212}Pb is retained on Sr Resin and ^{224}Ra is unretained. The ^{228}Th source is recovered from UTEVA Resin with a small volume of 0.5M HCl. Following a suitable ingrowth period, the ^{228}Th can be acidified to 4M HNO_3 and used to produce additional ^{224}Ra and ^{212}Pb . The ^{228}Th is preserved nearly completely and continuously purified from chemical and radiologic impurities run to run, allowing repeated use until radioactive decay depletes the ^{228}Th activity. ^{212}Pb may be recovered from Sr resin with a variety of reagents, including 6-8M HCl, citrate, tartrate, acetate and bioxalate.

Reagents

UTEVA Cartridges (Eichrom UT-R50-S)
 Sr Resin Cartridges (Eichrom SR-R50-S)
 ^{228}Th Source
 Deionized Water
 HCl
 HNO_3
Option for ^{224}Ra only:
 LN Resin cartridges (Eichrom LN-R50-S)

Equipment

Glass vials for storage of ^{228}Th source.
 Glass or plastic vials/bottles for collection of ^{224}Ra , ^{212}Pb and waste.
 10, 20 or 30mL plastic luer lock syringes
 Gamma Spectrometry System or alternative for measurement of ^{228}Th , ^{224}Ra , and ^{212}Pb .

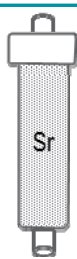


$^{212}\text{Pb}/^{224}\text{Ra}/^{228}\text{Th}$ Separation*

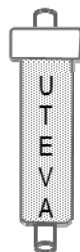
- (1) Precondition stacked 2mL cartridges of UTEVA and Sr Resins with 10mL 4M HNO_3 .
- (2) Acidify ^{228}Th eluate from previous separation with 5mL conc. HNO_3 . (If new ^{228}Th source, dilute to 20mL with 4M HNO_3 .)
- (3) Load $^{212}\text{Pb}/^{224}\text{Ra}/^{228}\text{Th}$ on UTEVA/Sr Resin. Collect ^{224}Ra .
- (4) Rinse UTEVA/Sr Resin with 10mL 4M HNO_3 . Collect ^{224}Ra .
- (5) Separate UTEVA/Sr Resin cartridges.



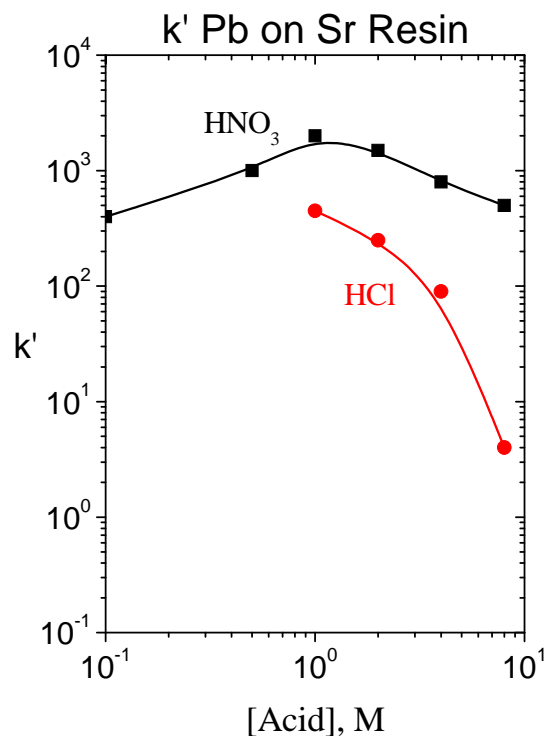
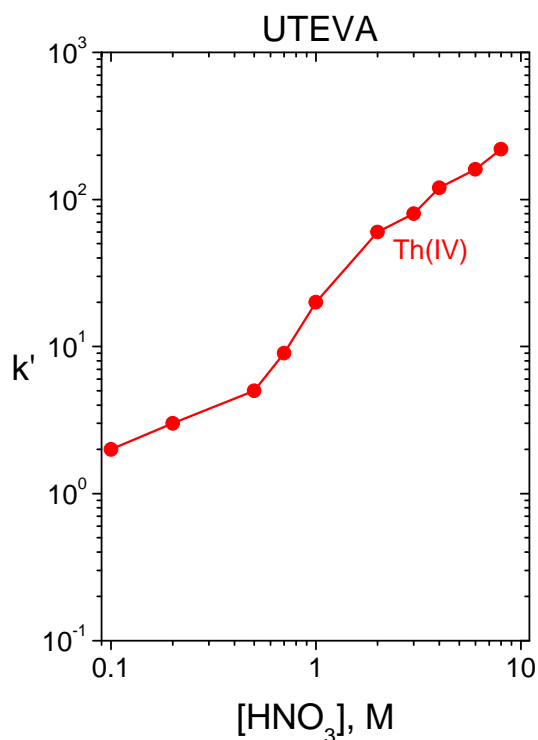
- (6) Rinse Sr Resin with 10mL 0.1M HNO_3 .
- (7) Strip ^{212}Pb from Sr Resin with one of the following:
 - 15mL 6M HCl
 - 10mL 8M HCl
 - 10mL 0.05 ammonium citrate
 - 10mL 0.05 ammonium tartrate
 - 10mL 0.05 ammonium acetate
 - 10mL 0.05 ammonium bioxalate



- (8) Strip ^{228}Th from UTEVA with 15mL 0.5M HCl . Recovery of ^{228}Th can be improved by stripping in opposite direction of load. Save ^{228}Th for future use.



*If only ^{224}Ra is desired, a simplified generator can be made by loading ^{228}Th onto a 2mL cartridge of LN resin from 0.1M HNO_3 . ^{224}Ra can then be periodically milked using 5-10mL of 0.1M HNO_3 or HCl .



References

- 1) McAlister and Horwitz, "Chromatographic Generator Systems for the actinides and natural decay series elements," *Radiochimica Acta*, 99:1-9 (2011).