AP4

DETERMINATION OF TOTAL RADIOSTRONTIUM IN ENVIRONMENTAL SAMPLES

PART A

PRINCIPLE

Soil, sediment, sludge, and biota samples are dissolved by a combination of potassium hydrogen fluoride and pyrosulfate fusions. Water samples may or may not be filtered and are subject to a pyrosulfate fusion. The fusion cake is dissolved and strontium is coprecipitated on lead sulfate. The strontium is separated from residual calcium and lead by reprecipitating strontium sulfate from EDTA at a pH of 4.0. Strontium is separated from barium by complexing the strontium in DTPA while precipitating barium as barium chromate. The strontium is ultimately converted to strontium carbonate and counted on a low-background gas proportional counter.

REFERENCES

1. C.W. Sill, K.W. Puphol and F.D. Hindman, Anal. Chem., 46, 1725 (1974)

2. Don B. Martin, Anal. Chem., 51, 1968 (1979)

Certification Record for

PROCEDURE AP4

DETERMINATION OF TOTAL RADIOSTRONTIUM IN ENVIRONMENTAL SAMPLES

CHECKPOINTS

1.	JOB HAZARD ANALYSIS	____
2.	MSDS/HAZARDS DISCUSSED	____
3.	KHF_2 and PYROSULFATE FUSIONS	____
4.	PRECIPITATION OF LEAD SULFATE	____
5.	PRECIPITATION OF STRONTIUM SULFATE	____
6.	PRECIPITATION OF BARIUM CHROMATE	____
7.	2ND PRECIPITATION OF STRONTIUM	____
	SULFATE AND RECORDING OF Y-90	____
	ELUTION TIME	____
8.	FINAL PRECIPITATION OF STRONTIUM	____
	CARBONATE FOR COUNTING	____
9.	FINAL CALCULATIONS	____

ANALYST SIGNATURE:_____

CERTIFIED BY: _____

DATE: _____

ANALYSIS VALUE: _____

KNOWN VALUE: _____

MEASURED/KNOWN RATIO:_____

COMMENTS: _____
_____
_____
_____
_____

PART B

1.0 PURPOSE AND SCOPE

This is a radiochemical procedure for the determination of total radiostrontium in environmental samples.

2.0 REAGENTS

All chemicals are hazardous. See MSDS for specific precautions. All prepared solutions need to be filtered using a 0.45 μm filter membrane. Unless otherwise indicated, all references to water should be understood to mean reagent grade water. **See step 2.0 of AP4 JHA.**

Acetic Acid, $HC_2H_3O_2$, Glacial, 17.4 M

Acetic Acid, 6 M: To 500 mL reagent water, add 342 mL Glacial Acetic Acid. Dilute to 1 L with reagent water.

Ammonium Oxalate, 5% (w/v): Dissolve 5 g $(NH_4)_2C_2O_4 \cdot H_2O$ in 80 mL reagent water. Dilute to 100 mL with water. Heat may be necessary to dissolve solid.

Barium Chloride Solution, 0.9% (w/v): Dissolve 9 g $BaCl_2 \cdot 2H_2O$ in 900 mL reagent water. Dilute to 1 L with reagent water.

Diethylenetriaminepentaacetic Acid, DTPA, 0.2 M: Dissolve 39 g DTPA and 25 g NaOH in 400 mL reagent water. Vacuum filter through a Supor 450 filter. Dilute to 500 mL with reagent water.
Note: More NaOH may be added if the DTPA does not completely dissolve with 25 g NaOH.

Fusion solution: Dissolve 50 g $NaHSO_4$ in 300 mL reagent water. **Slowly** add 125 mL 18 M H_2SO_4 while stirring. Cool, and dilute to 500 mL with reagent water.

Ethylenediaminetetraacetic Acid, EDTA, 0.6 M: To 800 mL reagent water, slowly add 223 g Disodium salt of EDTA while stirring. Heat gently and slowly add solid NaOH until the EDTA dissolves. Vacuum filter through a Supor-450 filter. Dilute to 1 L with reagent water. Alternate: Replace 223 g Na_2EDTA with 175 g H_4EDTA and 48 g NaOH.

Ethanol 95%

Sodium Hydroxide, NaOH, 10 M, Slowly dissolve 200 g NaOH in 450 mL reagent water. Dilute to 500 mL with reagent water. Store this solution in a plastic container.

Hydrochloric Acid, HCl, 12 M, concentrated

Hydrochloric Acid, 6 M: Slowly add 500 mL concentrated HCl to 450 mL reagent water. Dilute to 1 L with reagent water. Mix well.

Hydrogen Peroxide, H_2O_2, 30-35%

Lead Nitrate Solution, 1.6% (w/v): Dissolve 16 g $Pb(NO_3)_2$ in 800 mL reagent water. Dilute to 1 L with reagent water.

Metacresol Purple, MCP, indicator: Dissolve 0.1 g MCP in 26.2 mL 0.01 M NaOH. Dilute to 250 mL with reagent water.

Phenolphthalein indicator: Dissolve 0.05 g phenolphthalein in 50 mL 95% ethanol. Dilute to 100 mL with reagent water.

Potassium Wash: Dissolve 50 g K_2SO_4 in 700 mL reagent water. Add 4 mL concentrated H_2SO_4. Dilute to 1 L with reagent water.

Sodium Carbonate Solution, 10% (w/v): Slowly dissolve 100 g Na_2CO_3 in 800 mL reagent water. Filter through a Supor-450 filter. Dilute to 1 L with reagent water.

Sodium Chromate, Na_2CrO_4, 1.0 M: Dissolve 162 g Na_2CrO_4 in 800 mL reagent water. Filter through a Supor-450 filter. Dilute to 1 L with reagent water.

Sodium Hydroxide, 10 M: Slowly dissolve 200 g solid NaOH in 400 mL reagent water. Allow solution to cool. Filter through a Supor-450 filter. Dilute to 500 mL with reagent water. Store this solution in a plastic bottle.

Sodium Hydroxide, 16.4 M: Slowly dissolve 180 g solid NaOH in 225 mL reagent water. Allow solution to cool. Filter through a Supor-450 filter. Dilute to 275 mL with reagent water. Store this solution in a plastic bottle.

Sodium Sulfate, Na_2SO_4, 1.4 M: Slowly dissolve 199 g Na_2SO_4 in reagent water while stirring. Heat gently, if necessary. Dilute to 1 L with reagent water.

Strontium Carrier, 40 mg/mL: Dissolve 17.5 g of $SrCO_3$ in approximately 100 mL of reagent water and 25 mL of concentrated HCl. Filter through a Supor-450 filter or equivalent. Using a 250 mL volumetric flask, bring the solution to volume. Alternatively, use AA grade Sr carrier (10,000 ppm or 10mg/mL). To standardize the carrier solution, go to step 5.1.

Yttrium Carrier, 10mg/mL: AA quality Y carrier.

3.0 APPARATUS

Beakers, various sizes
Centrifuge
Centrifuge tube, 50 mL
Filters, 47mm 0.45 um (Supor-450 and DM-450 or equivalent)
Filter flasks
Hot plate
Low-background gas proportional counter
Planchette
Platinum dish
Stir Bars
Watch glass
Vortex mixer

4.0 PROCEDURE

4.1 General Requirements

Before proceeding, you must be certified as indicated in QCP1 of this manual and Section 3 of the Quality Program Manual. See page two for a copy of the certification record.

4.2 Sample Preparation

4.2.1 Measure and record sample quantity and media. Typical samples are 1 g dry soil, 0.05-0.25 L water or 10 g dry vegetation. Soil and vegetation are weighed into platinum dishes. Water is dried in platinum or transferred to a beaker for a pyrosulfate fusion. **See step 4.2.1 of AP4 JHA.**

4.2.2 Add an appropriate amount of Sr carrier, such that the theoretical yield of strontium carbonate is approximately 70-75 mg. For water samples that are in a beaker, add 2 mL of fusion solution, heat to dryness (the resulting residue forms a pyrosulfate cake), and go to step 4.2.14. **See step 4.2.2 of AP4 JHA**.

4.2.3 Take sample to hood. **See step 4.2.3 of AP4 JHA.**

4.2.4 Add an appropriate amount (typically 12-18 grams) of KHF_2 to the sample. **See step 4.2.4 of AP4 JHA.**

4.2.5 Place the platinum dish on a ring stand using a Nichrome triangle. **See step 4.2.5 of AP4 JHA**.

4.2.6 Start heating the sample over a blast burner with low flame. Heat until all of the moisture has been evaporated. Care must be taken so that the sample

does not "pop" which may result in sample loss. **See step 4.2.6 of AP4 JHA.**

4.2.7 Use as much heat as possible, with limited splattering, to bring the temperature to about 900□ C (The color of the Pt dish will turn cherry red.) Continue heating until total dissolution occurs. Swirl the hot melt to ensure removal of sample clinging to the sides of the dish. **See step 4.2.7 of AP4 JHA.**

4.2.8 Remove the melt from the burner and swirl gently around the dish to form a thin layer upon cooling. Wait 45 seconds before proceeding to step 4.2.9. (Never set hot platinum on iron). **See step 4.2.8 of AP4 JHA.**

NOTE: IT IS CRITICAL FOR THE FLUORIDE CAKE TO BE SOMEWHAT COOLER BEFORE THE ADDITION OF H_2SO_4 TO PREVENT SPLATTERING.

4.2.9 Add ~8 mL concentrated H_2SO_4 to the fluoride cake. Add another ~8 mL. The acid should be added to the edge of the dish and allowed to run to the bottom of the dish. **See step 4.2.9 of AP4 JHA.**

4.2.10 After the addition of the H_2SO_4, heat as fast as frothing will allow until the fluoride cake is totally dissolved and a thick slurry forms. **See step 4.2.10 of AP4 JHA.**

4.2.11 Remove from heat and add 3.0 g anhydrous Na_2SO_4 to the slurry. Place sample over the blast burner with small flame and heat until the slurry begins to turn a golden brown. Slowly increase the temperature until the slurry is completely melted, and then maintain this temperature for approximately 1 minute. **See step 4.2.11 of AP4 JHA.**

4.2.12 Remove the melt from the burner and swirl gently around the dish to form a thin layer upon cooling. **See step 4.2.12 of AP4 JHA.**

4.2.13 Transfer hardened pyrosulfate cake to sample container by gently bending dish to crack and loosen cake. **See step 4.2.13 of AP4 JHA.**

4.2.14 To a 1 L or 800 mL beaker, add 350 mL reagent water, 10 g Na_2SO_4, and a Teflon stir bar. Add 7 mL 12 M HCl while stirring. Cover and heat to boiling. Add the pyrosulfate cake and boil for 10 minutes. **See step 4.2.14 of AP4 JHA.**

4.2.15 While stirring add 1 mL of 30-35% H_2O_2 followed immediately by 10 mL of 1.6% $Pb(NO_3)_2$ and boil for one minute. Repeat the lead addition two more times. Remove stir bar. **See step 4.2.15 of AP4 JHA.**

4.2.16 If possible, allow the precipitate to settle overnight. **See step 4.2.16 of AP4 JHA.**

4.2.17 Siphon as much liquid as possible without disturbing the precipitate, then transfer the precipitate to a centrifuge tube using potassium wash. Centrifuge at 2000 RPM for 5 minutes. Decant and discard the supernate in HCl waste container. **See step 4.2.17 of AP4 JHA.**

4.2.18 Loosen the precipitate on a vortex mixer and add 5 mL reagent water and 1 drop of metacresol purple. Stir on a vortex mixer. Add 10 M NaOH dropwise, while stirring, to the purple end point. This is usually 1-4 drops. Add 10 mL 0.6 M EDTA. If the solution is not purple, add 10 M NaOH to the purple end point. Stir on a vortex mixer. Heat in a water bath until the precipitate dissolves. If any precipitate remains, see the Laboratory Manager or his designee. **See step 4.2.18 of AP4 JHA.**

4.2.19 Add 5 mL 1.4 M Na_2SO_4, and glacial acetic acid dropwise, to the yellow end point. If you are not certain you have reached the end point, add a couple more drops of glacial acetic acid. It is not uncommon for a small amount of precipitate to form at this point. **See step 4.2.19 of AP4 JHA.**

4.2.20 Add 5 mL of 6 M acetic acid to precipitate the strontium sulfate. Heat in water bath until the precipitate settles. Centrifuge at 2000 RPM for 3 minutes. Decant and discard supernate in lead waste container. **See step 4.2.20 of AP4 JHA.**

4.2.21 Loosen the precipitate on a vortex mixer and add 20 mL of 10% Na_2CO_3 to metathesize the strontium sulfate to strontium carbonate. Heat the solution in a water bath for 10 minutes. Centrifuge at 2000 RPM for 3 minutes. Decant and discard supernate in dilute acid waste container. **See step 4.2.21 of AP4 JHA.**

4.2.22 Add 2 mL of 6 M HCl to the strontium carbonate precipitate. After the effervescence stops, add 5 mL of 0.2 M DPTA, 1 drop of phenolphthalein, and 10 M NaOH dropwise, to the red endpoint. **See step 4.2.22 of AP4 JHA.**

4.2.23 Add 1 mL of 0.9% $BaCl_2$, and 5 mL of 1.0 M sodium chromate. Heat in water bath for 2 minutes. **See step 4.2.23 of AP4 JHA.**

4.2.24 Add 1 drop of phenolphthalein, and glacial acetic acid dropwise while stirring, to the yellow end point of the chromate ion. The amount of glacial acetic acid needed is usually between 2 to10 drops**. See step 4.2.24 of AP4 JHA.**

4.2.25 Add 1 mL of 6 M acetic acid. Heat in water bath for 10 minutes, and then cool for 2 minutes. Centrifuge at 2000 RPM for 5 minutes. **Decant and SAVE the supernate in a new centrifuge tube.** Discard the barium chromate into the barium waste container. **See step 4.2.25 of AP4 JHA.**

Note: Do not proceed beyond this point, unless the procedure can be completed, typically 30-45 minutes.

4.2.26 Place a DM-450 filter on a stainless steel planchette and dry under a heat lamp for 20 minutes. Allow the filter to cool for 10 minutes. Weigh and record total weight on data sheet. **See step 4.2.26 of AP4 JHA.**

4.2.27 Add 10 mL of 1.4 M Na_2SO_4 and 2 mL of glacial acetic acid to the supernate, to precipitate strontium sulfate. RECORD THE TIME AS ELUTION TIME ON THE DATA SHEET. (The start of Y-90 ingrowth.) Heat the solution in a water bath for 5 minutes. Centrifuge at 2000 RPM for 5 minutes. Decant and discard the supernate in the barium chromate waste container. **See step 4.2.27 of AP4 JHA.**

4.2.28 Thoroughly loosen the precipitate on a vortex mixer. Add 20 mL of 10% Na_2CO_3 to metathesize the strontium sulfate to strontium carbonate. Heat and stir the solution for 10 minutes. Cool for 2 minutes. **See step 4.2.28 of AP4 JHA.**

4.2.29 Filter the carbonate precipitate on the DM-450 filter paper, using low suction. Wash the filter with reagent water. After the water has passed, add 95% ethanol. Record the filter time on the data sheet. **See step 4.2.29 of AP4 JHA.**

4.2.30 Dry filter under a heat lamp for 20 minutes. Weigh sample filter with planchette and record on data sheet. Wait 4 hours, and count on a low background gas proportional counter. **See step 4.2.30 of AP4 JHA.**

4.2.31 Discard the liquid filtrate in the dilute acid waste container. **See step 4.2.31 of AP4 JHA.**

5.0 CALIBRATION

5.1 Standardization of Strontium Carrier

5.1.1 To 9-12 centrifuge tubes, add 5 mL of reagent water and enough Sr^{2+} carrier so that there is ~40 mg Sr^{2+} . Mix well on a vortex mixer. **See step 4.2.2 of AP4 JHA.**

5.1.2 Add 20 mL of 10% Na_2CO_3 and heat in a hot water bath for ~10 minutes to

precipitate $SrCO_3$. **See step 4.2.28 of AP4 JHA.**

5.1.3 Place a DM-450 filter on a stainless steel planchette, weigh and record the total weight on data sheet. **See step 4.2.26 of AP4 JHA.**

5.1.4 Filter the carbonate on the tared DM-450 filter paper, using low suction. Wash the filter with reagent water. After the water has passed, add 2-3 mL 95% ethanol. Air dry for approximately 1 hour. Weigh the sample filter and planchette and record on data sheet. **See step 4.2.29 of AP4 JHA.**

5.1.5 The net weights, in mg, of the 9-12 aliquots are averaged to standardize the mass of the $SrCO_3$. This averaged mass will be used as the theoretical yield of the $SrCO_3$. The chemical yield will be calculated based on this theoretical yield.

5.2 Standardization of Yttrium Carrier

5.2.1 To 9-12 centrifuge tubes, add 1 mL of the Y^{3+} carrier. **See step 5.2.1 of AP4 JHA.**

Note: This solution is now approximately 10 mg/mL Y^{3+} and 34 mg/mL $Y_2(C_2O_4)_3 \cdot 9H_2O$.

5.2.2 Add 5 mL reagent water and 5 mL 5% $(NH_4)_2C_2O_4 \cdot H_2O$ to each tube. **See step 5.2.2 of AP4 JHA.**

5.2.3 Heat in a hot water bath for 10 minutes. **See step 5.2.3 of AP4 JHA.**

5.2.4 Place ten DM-450 filters on a stainless steel planchettes and dry under a heat lamp for 20 minutes. Allow to cool and weigh the filters.

5.2.5 Vortex solution. Filter through DM-450 filter. **See step 5.2.5 of AP4 JHA.**

5.2.6 Dry precipitate and filter under a heat lamp for 15 minutes. Allow to cool.

5.2.7 Weigh the $Y_2(C_2O_4)_3 \cdot 9H_2O$. **See step 5.2.7 of AP4 JHA.**

5.2.8 The net weights, in mg, of the 9-12 aliquots are averaged to standardize the mass of the $Y_2(C_2O_4)_3 \cdot 9H_2O$. This averaged mass will be used as the theoretical yield of the $Y_2(C_2O_4)_3 \cdot 9H_2O$. The chemical yield will be calculated based on this theoretical yield.

5.3 Efficiency Calibration

5.3.1 Add a known amount of Sr^{2+} and Y^{3+} carriers to a 50 mL centrifuge tube. The amounts should be such that the final $SrCO_3$ and $Y_2(C_2O_4)_3 \cdot 9H_2O$

should weigh approximately 70 mg and 35 mg, respectively. **See step 4.2.2 of AP4 JHA.**

5.3.2 Add a known amount (~ 100 to 500 pCi) of NIST traceable Sr-90 standard to each tube. **See step 4.2.2 of AP4 JHA.**

5.3.3 Add 2 mL of 6 M HCl to each centrifuge tube. Add 5 mL of 0.2 M DTPA, 1 drop of phenolphthalein, and 10 M NaOH dropwise, to the red end point. **See step 4.2.22 of AP4 JHA.**

5.3.4 Add 1 drop of phenolphthalein, and glacial acetic acid dropwise while stirring, until solution is colorless. Add 1 mL of 6 M acetic acid. **See steps 4.2.24 and 4.2.25 of AP4 JHA.**

5.3.5 Add 10 mL of 1.4 M Na_2SO_4 and 2 mL of glacial acetic acid to precipitate $SrSO_4$. RECORD THIS TIME AS THE ELUTION TIME. Heat in a water bath until the precipitate settles. Centrifuge and decant the supernate into a new centrifuge tube. Save this solution for the Y^{3+} calibration (starting with step 5.3.9). **See step 4.2.27 of AP4 JHA.**

5.3.6 Thoroughly loosen the precipitate on a vortex mixer. Add 20 mL of 10% Na_2CO_3. Heat in water bath for 10 minutes. **See step 4.2.28 of AP4 JHA.**

5.3.7 Place a DM-450 filter on a stainless steel planchet. Heat filter paper under heat lamp for 15 minutes. Allow filter to cool and weigh and record total weight on data sheet. **See step 4.2.26 of AP4 JHA.**

5.3.8 Filter the $SrCO_3$ on to the tared DM-450 filter paper, using low suction. Wash the filter with reagent water. After the water has passed, add 2-3 mL 95% ethanol. Record the filtration time on the data sheet. Dry filter under a heat lamp for 15 minutes. Allow filter to cool for 15 minutes and re-weigh filter and planchet and record on data sheet. Count on low background alpha-beta counter. **See steps 4.2.29 and 4.2.30 of AP4 JHA.**

5.3.9 To the supernate from step 5.3.5, add 7.5 mL 16.4 M NaOH. Heat in hot water bath for 10 minutes. Centrifuge for 10 minutes and discard supernate into the sanitary sewer using copious amounts of water. **See step 5.3.9 of AP4 JHA.**

5.3.10 Dissolve the precipitate with 2 mL 6 M HNO_3. **See step 5.3.10 of AP4 JHA.**

5.3.11 Add 5 mL reagent water and 3 mL 10 M NaOH. Heat for 5 minutes. Centrifuge for 5 minutes and discard supernate into the sanitary sewer using copious amounts of water.

See step 5.3.11 of AP4 JHA.

5.3.12 Dissolve the precipitate in 1 mL 6 M HNO_3. Add 5 mL reagent water. **See step 5.3.12 of AP4 JHA.**

5.3.13 Add 5 mL 5% $(NH_4)_2C_2O_4 \cdot H_2O$. Heat for 5 minutes. **See step 5.3.13 of AP4 JHA.**

5.3.14 Filter the $Y_2(C_2O_4)_3 \cdot 9H_2O$ on to the tared DM-450 filter paper, using low suction. Wash the filter with reagent water. After the water has passed, add 2-3 mL 95% ethanol. Record the filtration time on the data sheet. Dry filter under a heat lamp for 15 minutes. Allow filter to cool for 15 minutes and re-weigh filter and planchet and record on data sheet. Count on low background alpha-beta counter. **See steps 4.2.29 and 4.2.30 of AP4 JHA.**

6.0 CALCULATIONS

Critical data values will be documented on standard forms maintained as critical records. The following equations define the critical data values. All data will be recorded and reduced according to these calculations.

$$Concentration = \frac{G - B}{Tc \cdot Q \cdot Y \cdot (E1 + (E2 \cdot I))} = pCi / unit$$

$$2\sigma\ Error = \frac{1.96\sqrt{B + G}}{Tc \cdot Q \cdot Y \cdot (E1 + (E2 \cdot I))} = pCi / unit$$

$$2\sigma\ TPU = C \cdot 1.96\sqrt{\frac{G + B}{(G - B)^2} + RE1^2 + RE2^2 + RI^2 + RY^2 + RQ^2} = pCi / unit$$

$$MDC = \frac{3 + 4.65\sqrt{B}}{Tc \cdot Q \cdot Y \cdot (E1 + (E2 \cdot I))} = pCi / unit$$

$$E1 = \frac{G_{E1} - B}{E1_{ACT}} = cpm / pCi$$

$$E2 = \frac{G_{E2} - B}{E2_{ACT}} = cpm / pCi$$

Added yttrium ingrowth equation.

$$I = 1 - e^{-(\ln 2 / 64.1)T}$$

Where:	B	=	background counts
	C	=	concentration
	E1	=	Sr90 efficiency (cpm/pCi)
	$E1_{ACT}$	=	Sr-90 activity
	E2	=	Y90 efficiency (cpm/pCi)
	$E2_{ACT}$	=	Y-90 activity
	G	=	gross counts
	G_{E1}	=	efficiency sample gross counts/minute Sr-90
	G_{E2}	=	efficiency sample gross counts/minute Y-90
	I	=	Yttrium ingrowth
	MDC	=	minimum detectable concentration
	Q	=	sample quantity
	RE1	=	1σ relative uncertainty of the Sr90 efficiency
	RE2	=	1σ relative uncertainty of the Y90 efficiency
	RI	=	1σ relative uncertainty of the Y90 ingrowth
	RY	=	1σ relative uncertainty of the yield
	RQ	=	1σ relative uncertainty of the quantity
	T	=	Yttrium ingrowth time (hours)
	Tc	=	count time (min)
	TPU	=	total propagated uncertainty
	Y	=	chemical yield

7.0 RECORDS

7.1 Reference QA Manual for general record requirements.

7.2 The raw count data are saved during the weekly backup of the Low Background Alpha/Beta counter to the ORISE network disks.

7.3 Hard copies of assignment and calculation sheets are maintained in the archived site file. Electronic copies of assignment and calculation sheets are saved during the daily incremental backup of the network system. The following data sheets show the required data and information. These forms or the equivalent should be completed and retained:

- Total Radiostrontium Analysis Assignment Form
- Total Radiostrontium Lab Data Sheet

- Total Radiostrontium Concentration and Uncertainty Report (This report may be generated using approved Excel spreadsheets or from the database, if available.)

AP4(Rev 14) - TOTAL Sr ANALYSIS ASSIGNMENT FORM

Assigned To: _____ **Date:** _____ **Batch:** _____

Task #: _____ **LWR #:** _____ **Activity Level*:** _____

Sample #s: _____

_____

_____

QC Required:

Blank ☐

LCS ☐ **Sr-90 STD #** _____ **Quantity:** _____ **Initials** ☐

Units: _____

Pipette # _____ Volume (mL) _____ Weight (g) _____

Replicate ☐ **Sample #** _____ **# Replicates:** _____

Matrix Spike ☐ **Sample #** _____ **Initials** ☐

Sr-90 STD # _____ **Quantity:** _____

Units: _____

4 mL CARRIER ADDED? **Initials** ☐

SPECIAL INSTRUCTIONS: _____

_____

_____

_____

* If Activity Level is indicated as Moderate or High, perform area survey.

COMMENTS: _____

_____

_____

_____

AP4(Rev 14) - TOTAL Sr ANALYSIS ASSIGNMENT FORM

Carrier #							
Sample #							
Sample Quantity							
Quan. Units							
Dry/Ash Ratio							
Filtration Time							
Elution Date							
Elution Time							
$SrCO_3$+Pln Wt. (g)							
Pln+Flt Wt. (g)							

Carrier #							
Sample #							
Sample Quanitity							
Quan. Units							
Dry/Ash Ratio							
Filtration Time							
Elution Date							
Elution Time							
$SrCO_3$+Pln Wt. (g)							
Pln+Flt Wt. (g)							

Carrier #							
Sample #							
Sample Quanitity							
Quan. Units							
Dry/Ash Ratio							
Filtration Time							
Elution Date							
Elution Time							
$SrCO_3$+Pln Wt. (g)							
Pln+Flt Wt. (g)							

Carrier #			
Sample #			
Sample Quanitity			
Quan. Units			
Dry/Ash Ratio			
Filtration Time			
Elution Date			
Elution Time			
$SrCO_3$+Pln Wt. (g)			
Pln+Flt Wt. (g)			

AP4(Rev 14) - TOTAL STRONTIUM CONCENTRATION & UNCERTAINTY REPORT

FILTRATION TIME						

OPERATOR INITIALS **DATE** **BATCH #** **TASK #**

DETECTOR # 1

Carrier #						
SAMPLE #						
Wt. of ash sample, g						
Dry/Ash ratio						
Calculated Dry Wt., g						
Wt. of unashed sample, g						
Volume of Water, L						
If Total, enter 1						
Elution Date (M/D/Y)						
Elution Time (H:M)						
Count Date & Time						
Length of Count, min						
Total Beta Counts						
BKG Beta Counts						
Weight of $SrCO_3$ + Planchet, g						
Weight of Planchet, g						
Weight of $SrCO_3$, mg						
Theoretical Yield, mg						
Sr Yield						

AP4(Rev 14) - TOTAL STRONTIUM CONCENTRATION & UNCERTAINTY REPORT

OPERATOR **DATE** **BATCH #** **TASK #**

Sample ID	Concentration	TPU	4.65-sigma MDC

Sr-90 Known pCi Uncertainty

Meas/Known Uncertainty

BLANK CORRECT? YES[ ] NO[ ] **INIT_____**

LCS CORRECT? YES[ ] NO[ ] **INIT_____**

SAMPLE YIELD CORRECT? YES[ ] NO[ ] **INIT_____**

IF NO, SPECIFY REASON:

ANALYST REVIEW: _____ **DATE:_____**

REVIEWED BY:_____ **DATE:_____**

GIVEN TO: _____ **DATE:_____**

QC ENTERED BY:_____ **DATE:_____**