Actinides and Sr-89/90 in Animal Tissue

Sherrod L. Maxwell
Washington Savannah River Co.
52nd Radiobioassay and Radiochemical Measurements Conference

October 23, 2006

Background

- Pu/Sr levels monitored at SRS in fish, deer, beef, etc.
- Request to add Np, Am, Cm and U
- Previous method
  - Wet ash/furnace
  - Large Anion Resin Column
  - Sr Resin after carbonate precipitation from eluant

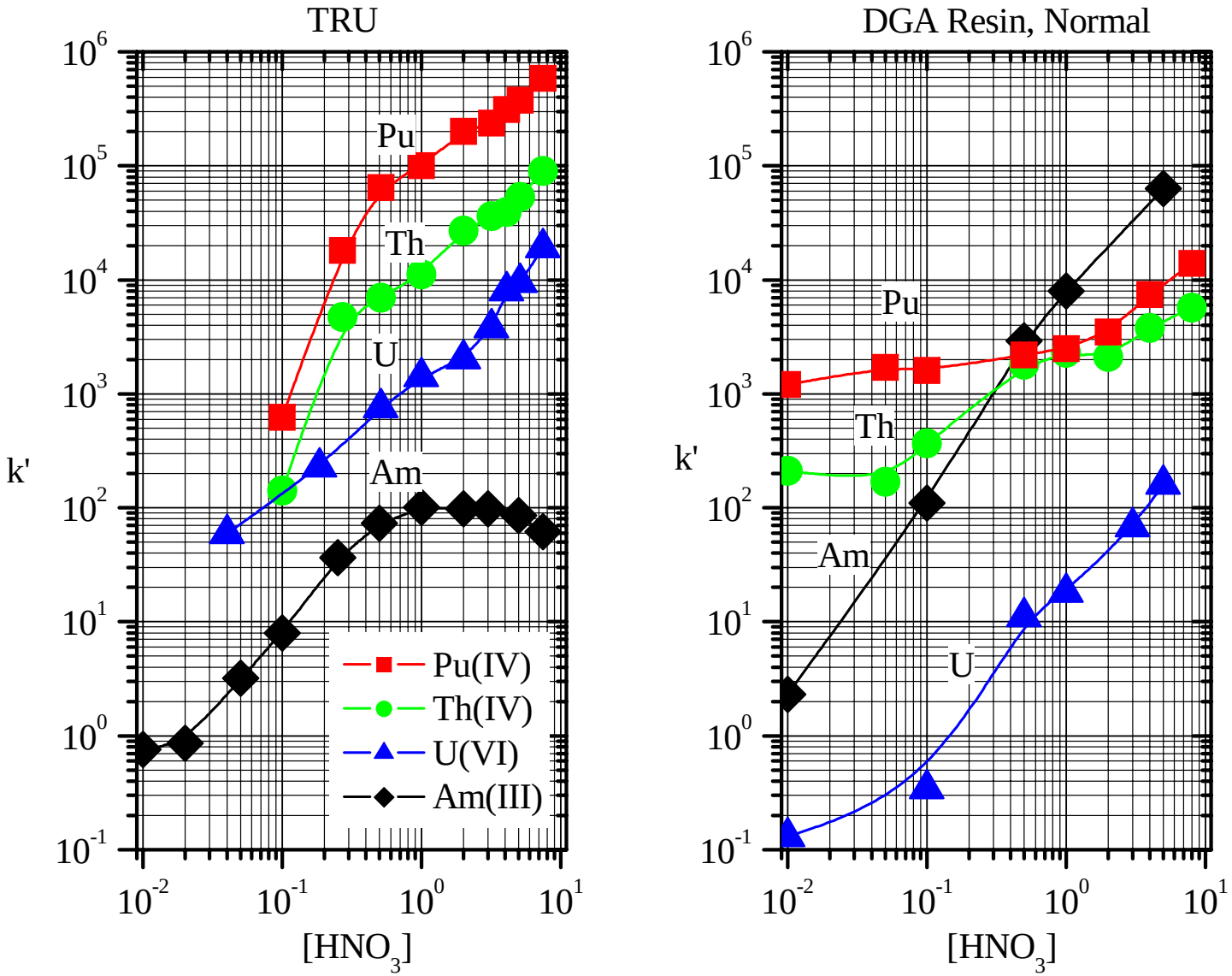
Actinides and Sr-89/90 in Animal Tissue

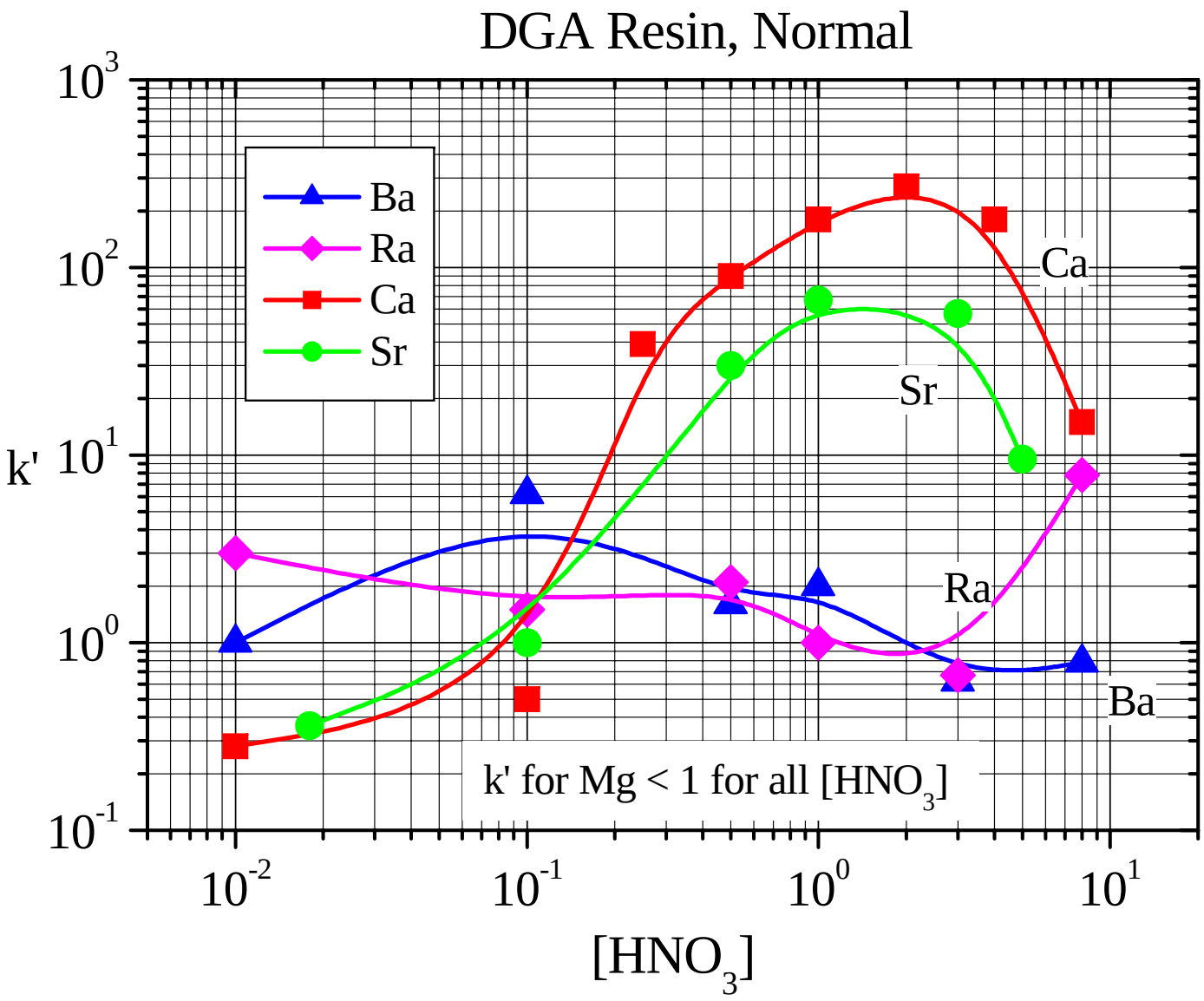
- Actinides in fish/animal tissue (200g)
  - TEVA + TRU + Sr Resin
    - Initial tests ok
    - Large load solution –Am/Cm losses
  - DGA enables Am/Cm assay using large load required to dissolve residual solids

Actinides/Sr in Fish/Animal Tissue

- 200 g fish
- Wet ash /furnace
- 30-45 ml load solution
- Pu, U, Am, Cm, Np, Sr
- TEVA+TRU+DGA
- DGA –good Am/Cm recovery
- Sr Resin

Comparison of TRU and DGA Resins




DGA Resin, Normal
Ba
Ra
Ca
Sr
k'
10^3
10^2
10^1
10^0
10^{-1}
10^{-2}
10^{-1}
10^0
10^1
[HNO$_3$]
k' for Mg < 1 for all [HNO$_3$]

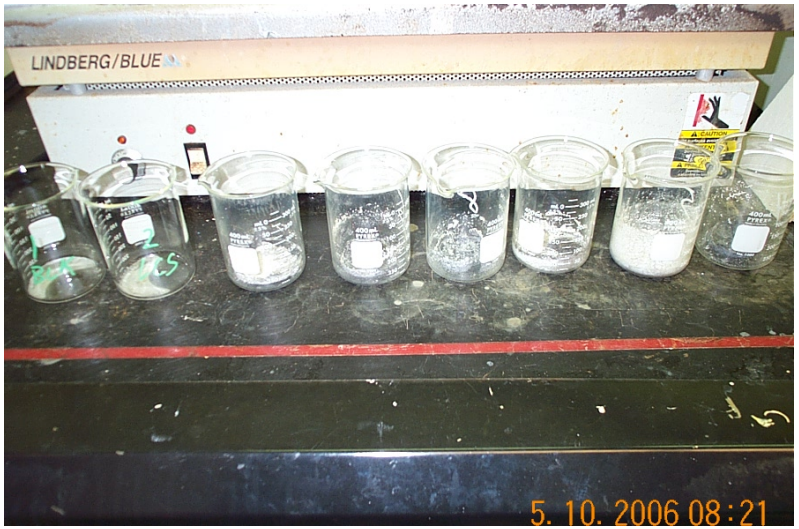
Actinides/Sr in Fish Method

- 200 g fish
- Wet ash
  - aqua regia/HNO_3/H_2O_2
- Furnace
  - 550C
- Dissolve in 12 ml 6M HNO_3 +12 ml 2M $Al(NO_3)_3$ + 3M HNO_3 as needed (~40-45 ml load solution)
- Load to TEVA+TRU+DGA
  - after valence adjustment
    - using sulfamic acid, iron (if Np-237 needed), ascorbic acid, followed by sodium nitrite
- Collect load/rinse (evaporate and redissolve later in 8M HNO_3 for Sr Resin)

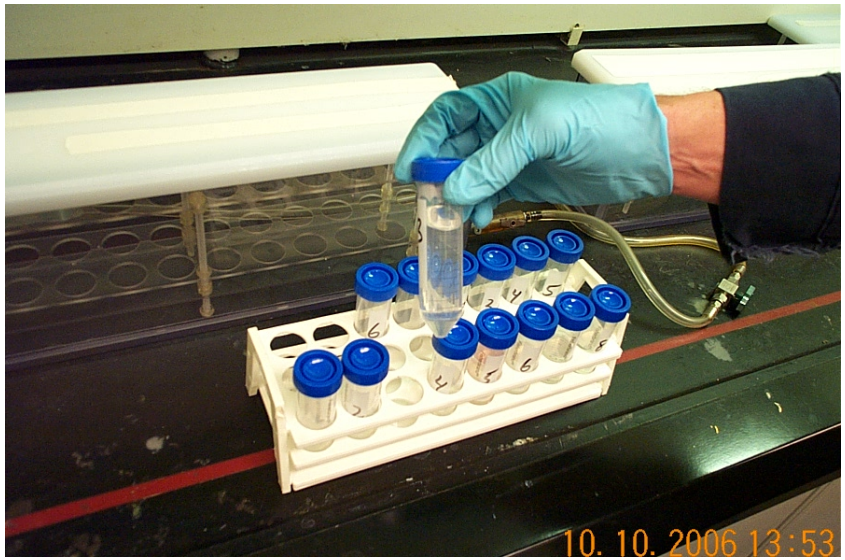
TEVA+TRU+DGA Resins

Preparation of 200 g Fish Sample

Preparation of 200 g Fish Sample



Preparation of 200 g Fish Sample



Actinides/Sr in Fish Method

- DGA alone:
  - Rinse DGA with 8 ml 0.1M HNO3
  - Save rinse to add to TRU Resin later (after increasing HNO3)
    - Contains some Sr and possible U
- Place TRU cartridge above DGA and elute Am/Cm from TRU onto DGA with 15 ml 4M HCL
  - Discard rinse
- Rinse DGA (alone) with 3 ml 1M HNO3/10 ml 0.1M HNO3
  - Discard rinse
- Elute Am/Cm from DGA with 10 ml 0.25M HCl
  - Cerium fluoride precipitation

Actinides/Sr in Fish Method

- Add DGA rinse that was set aside to TRU
  - Add 4 ml of con. HNO_3 to 8 ml of 0.1M HNO_3 rinse from DGA
  - Load to TRU Resin (alone)
  - Collect eluant through TRU
  - Possible Sr/add to evaporated load solution for Sr
- Rinse TRU with 12 ml 4M HCL-0.2M HF
  - Th removal
- Elute U from TRU with 15 ml 0.1M ammonium bioxalate
  - Cerium fluoride precipitation

Actinides/Sr in Fish Method

- Typically use two vacuum boxes so TEVA work can be done while DGA/ TRU work is done
- Rinse TEVA Resin with 15 ml 3M HNO_3
- Remove Th with 20 mL 9M HCL
- Elute Pu/Np with 20 ml 0.1M HCL-0.05M HF-0.03M $TiCl_3$
  - Cerium fluoride precipitation

Sr-89/90 Separation

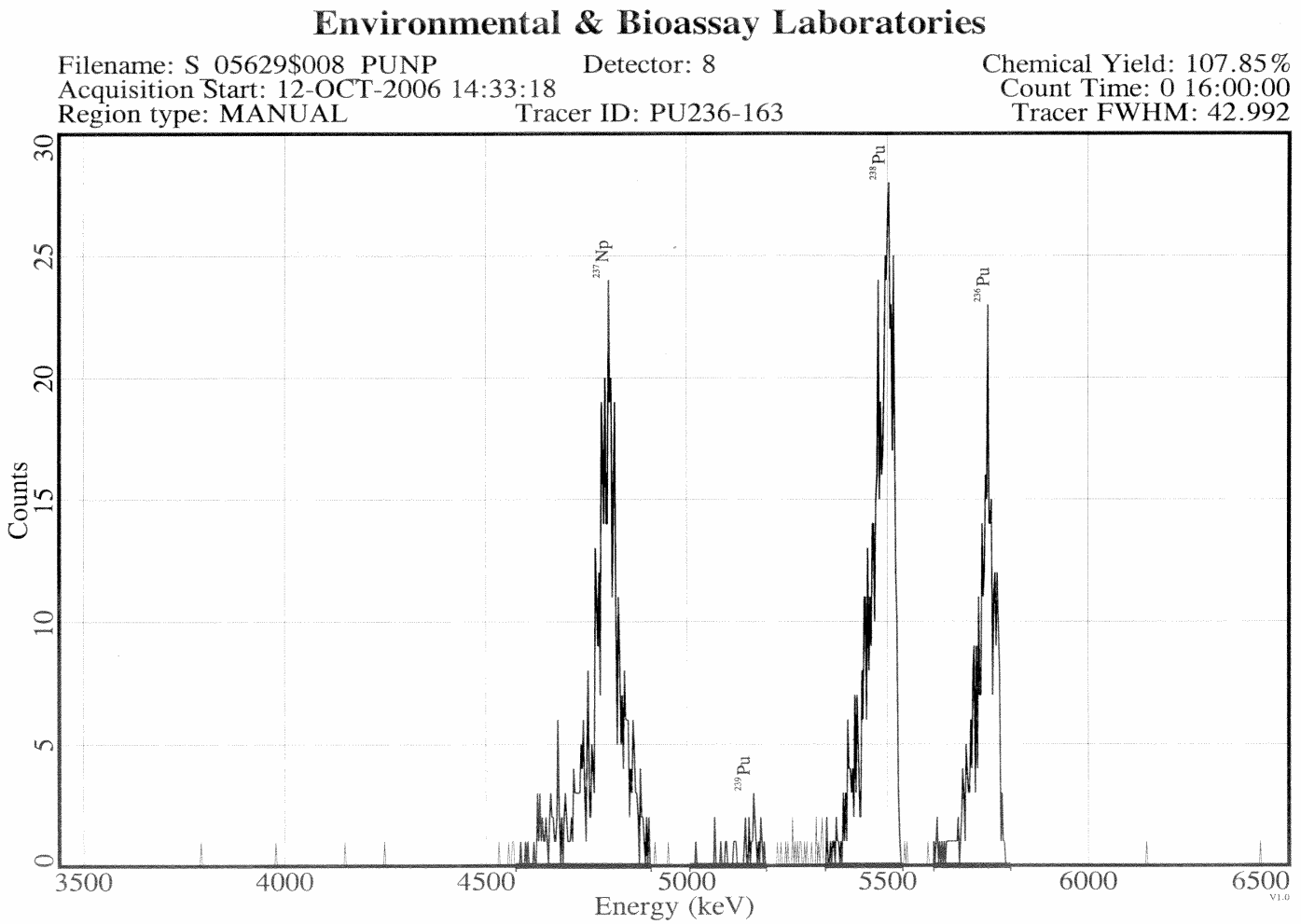
Redissolve evaporated load/rinses in 15 ml 8M HNO_3 + 5 -10 ml more of 3M HNO_3 as needed

-Use 3 ml Sr Resin (2mL+1 ml)
-15 ml 8M HNO_3 column rinse
-15 ml 0.05M HNO_3 column strip
-Mount on planchet/carrier recovery

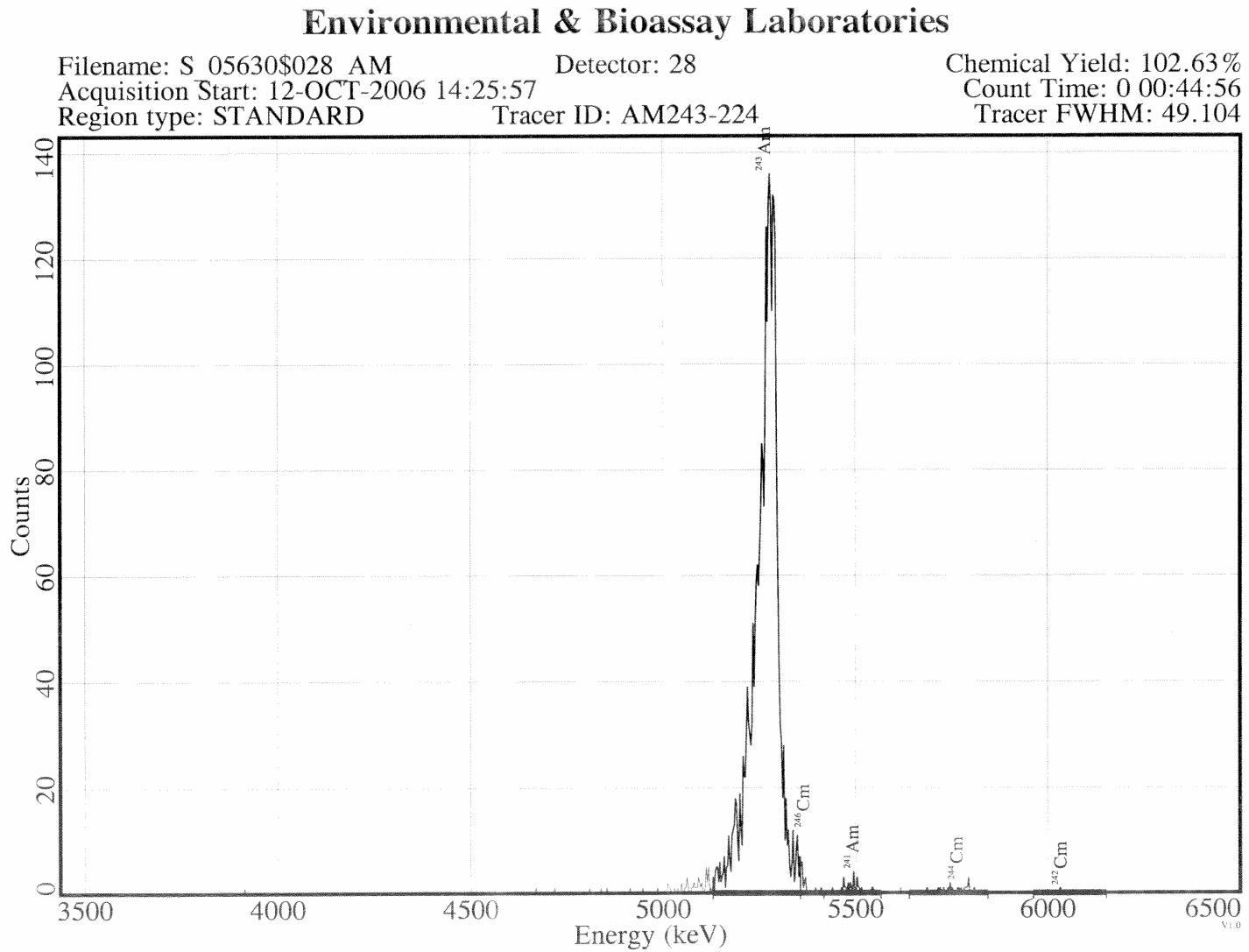
Actinides and Sr-90 in Fish Data

Tracer/carrier	Avg. Recovery	MS Recovery
Pu-236	99.8%	100% (Pu-238) 90.0% (Np-237)
Am-243	109%	94.1% (Am-241) 94.3% (Cm-244)
U-232	97.1%	91.1% (U-235)
Sr carrier	84.9%	97.7% (Sr-90)

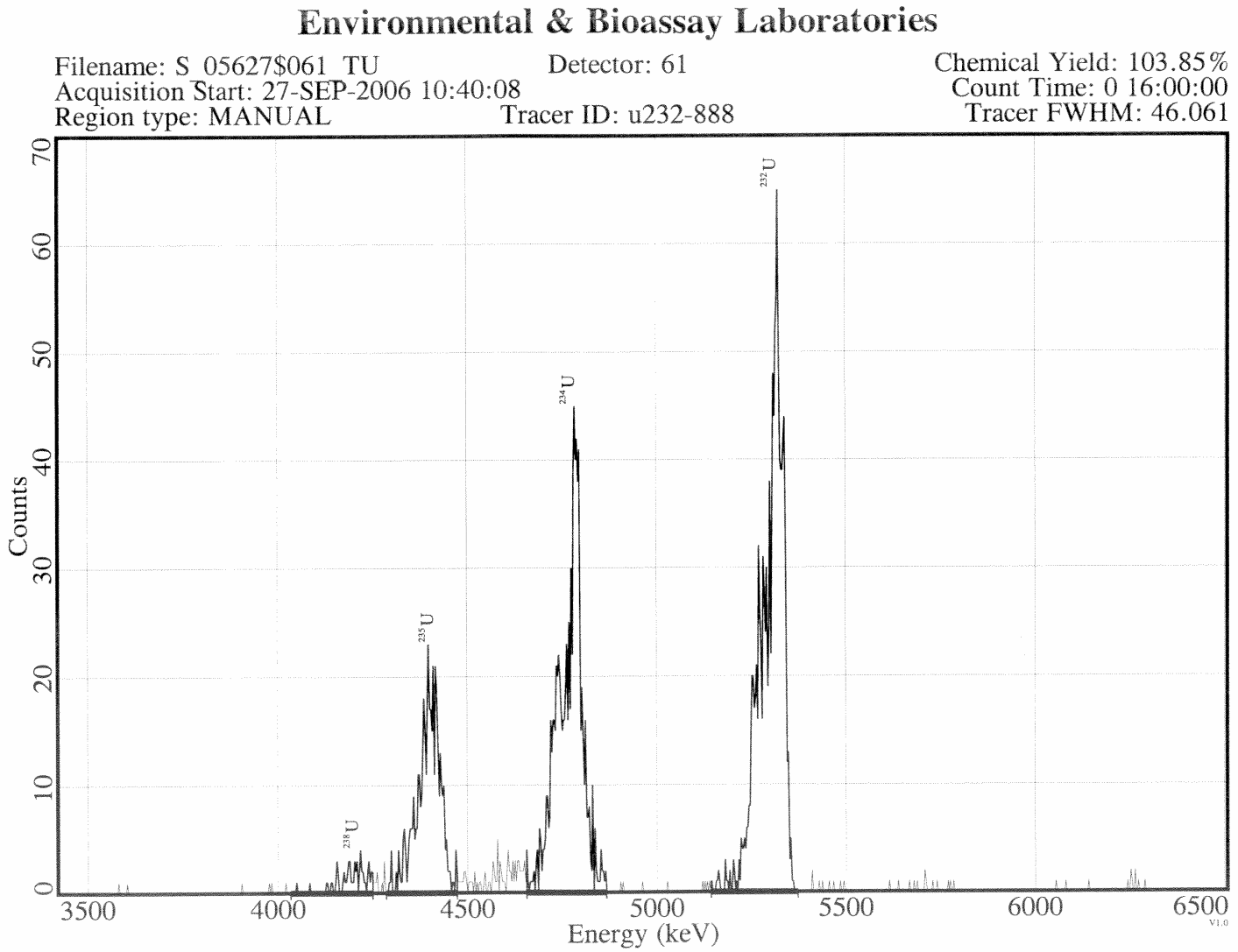
Pu-Np Spectra



Am/Cm Spectra



U Isotopes Spectra



Summary

- TEVA + TRU + DGA Resin can be applied to large fish samples (other animal tissue)
  - Sequential method
  - Tracer recoveries good
  - Matrix spike recoveries good
- DGA solves Am/Cm recovery problem
  - enables high Am/Cm tracer recoveries even with large load solutions and difficult sample matrix
- Sr-89/90 can be recovered through DGA with proper rinsing