South River Sediment Coring Project Update

E. E. Mack,

September 9, 2003

Sediment Sampling Plan

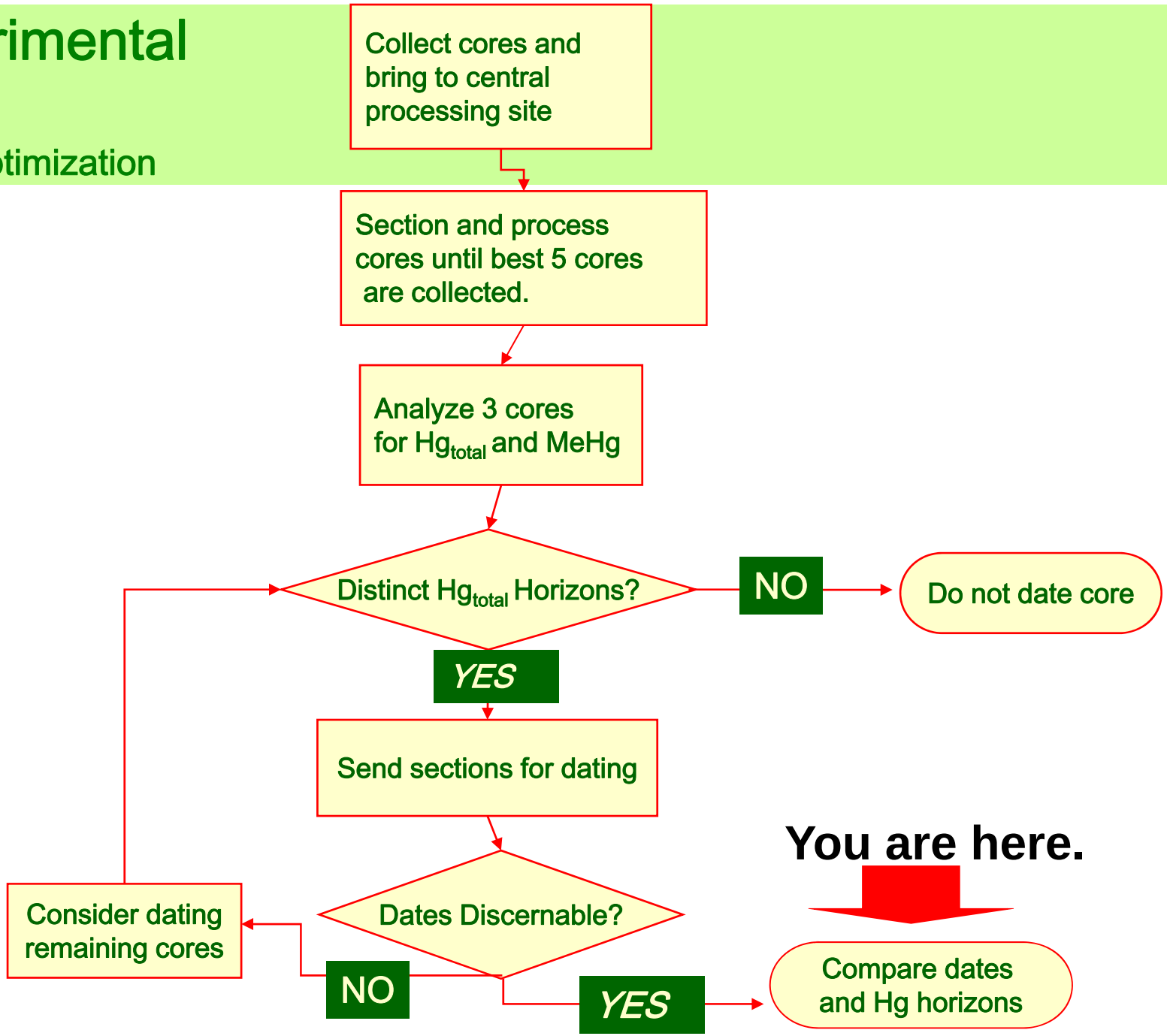
- rationale and goals

- Rationale:
  - Stable sediments will provide a historic record of mercury inputs into the S. River.

- Specific Goals
  - Characterize extent and patterns of Hg_t and MeHg in sediments found in selected depositional areas of the riverbed.
  - Compare Hg profiles in sediment collected in main river and sediments collected from a tributary that cuts through the flood plain.
  - Compare collected data with historic grab sample data when possible.

Experimental Logic

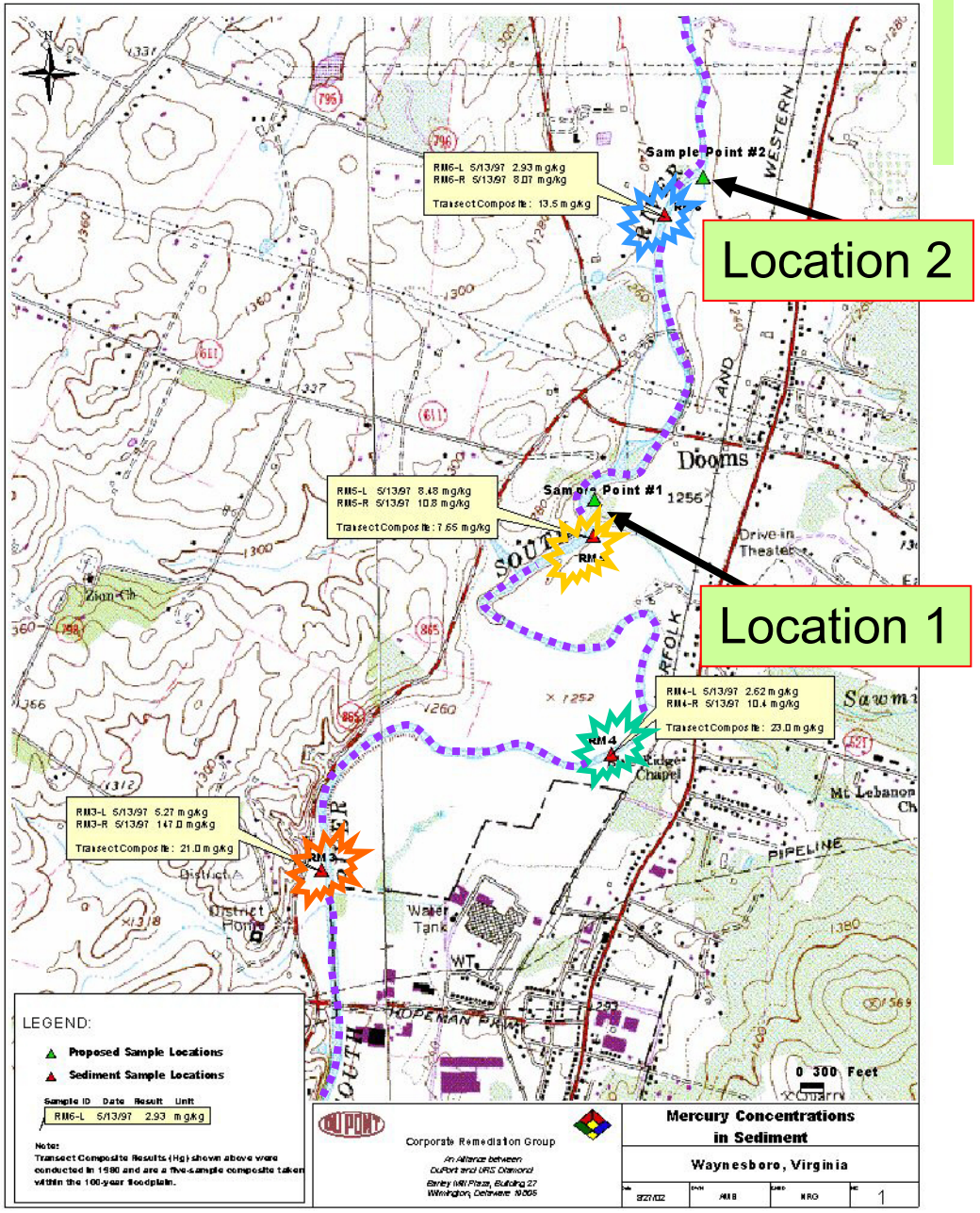
-Cost Optimization



Sampling Locations

Sediment Hg (ppm)

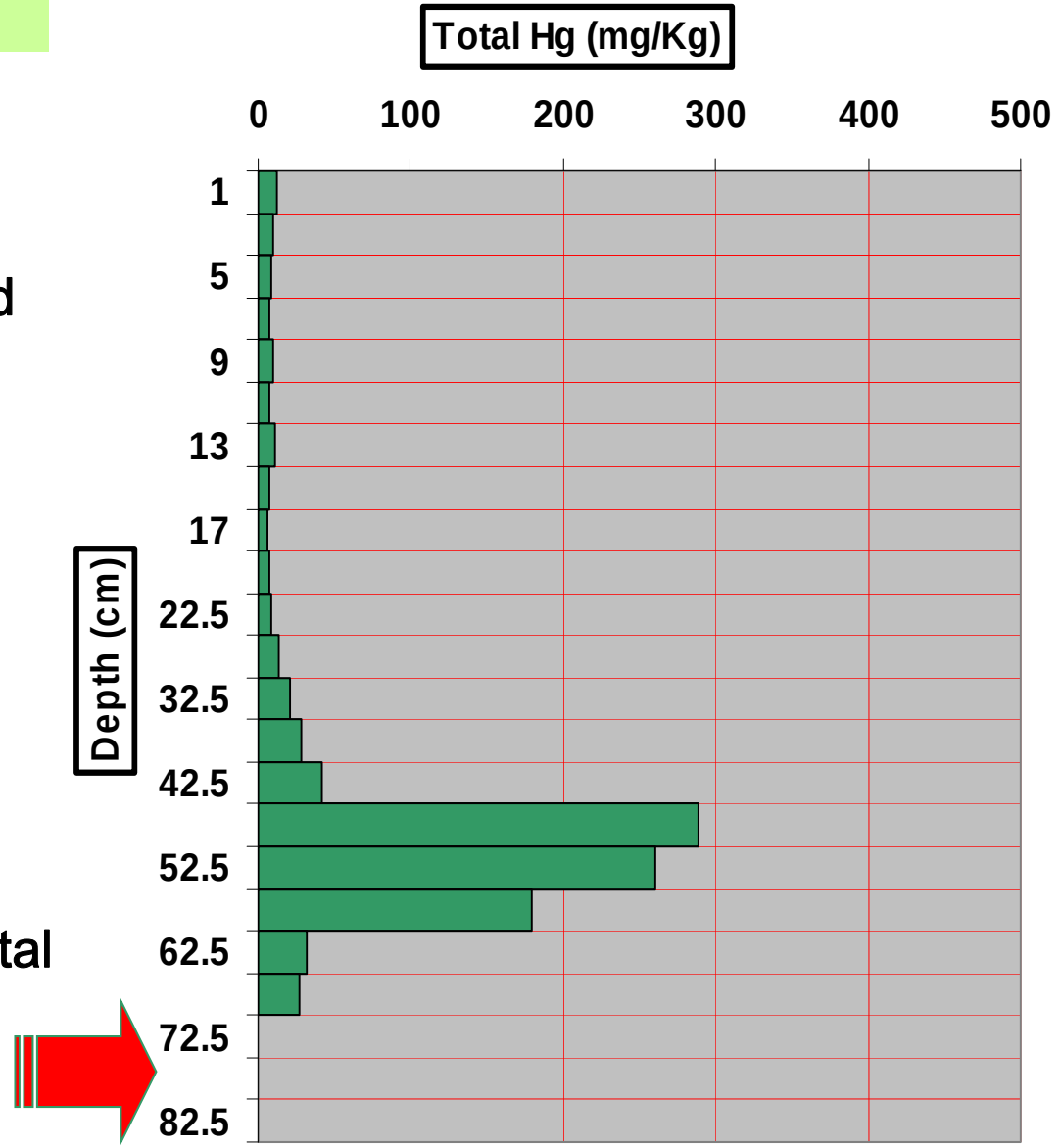
Left Bank	Right Bank	Transect Com-posite
2.93	8.07	13.5
8.48	10.8	7.65
2.62	10.4	23.0
5.27	147.0	21.0



Site 1 (Dooms' Dam) – Core 4

- Distinct horizon of elevated total Hg at 32 to 65 cm.
- Below 65 cm Hg total decreases significantly.

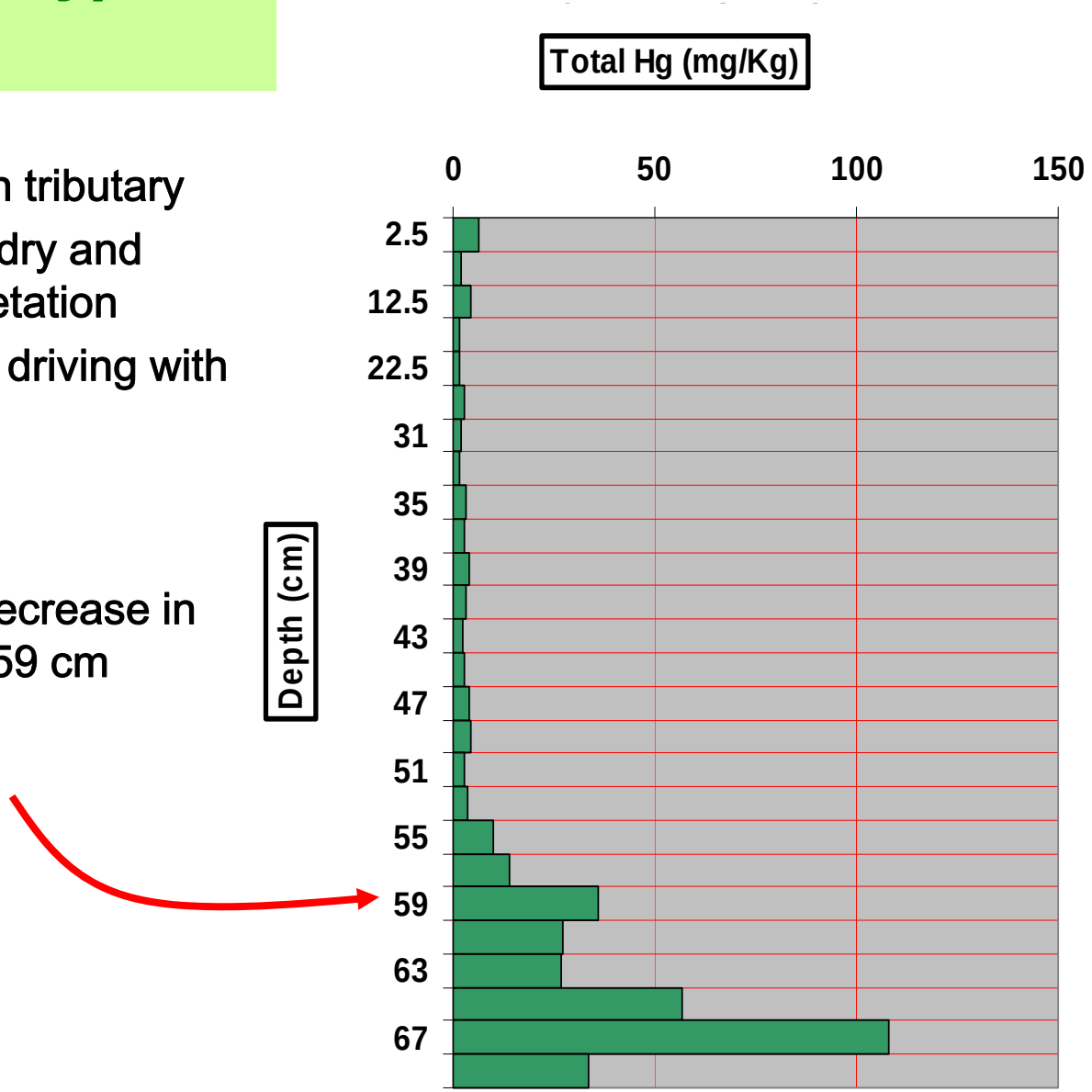
- Between 70 and 85 cm Total Hg = 0.23 – 1.2 ppm



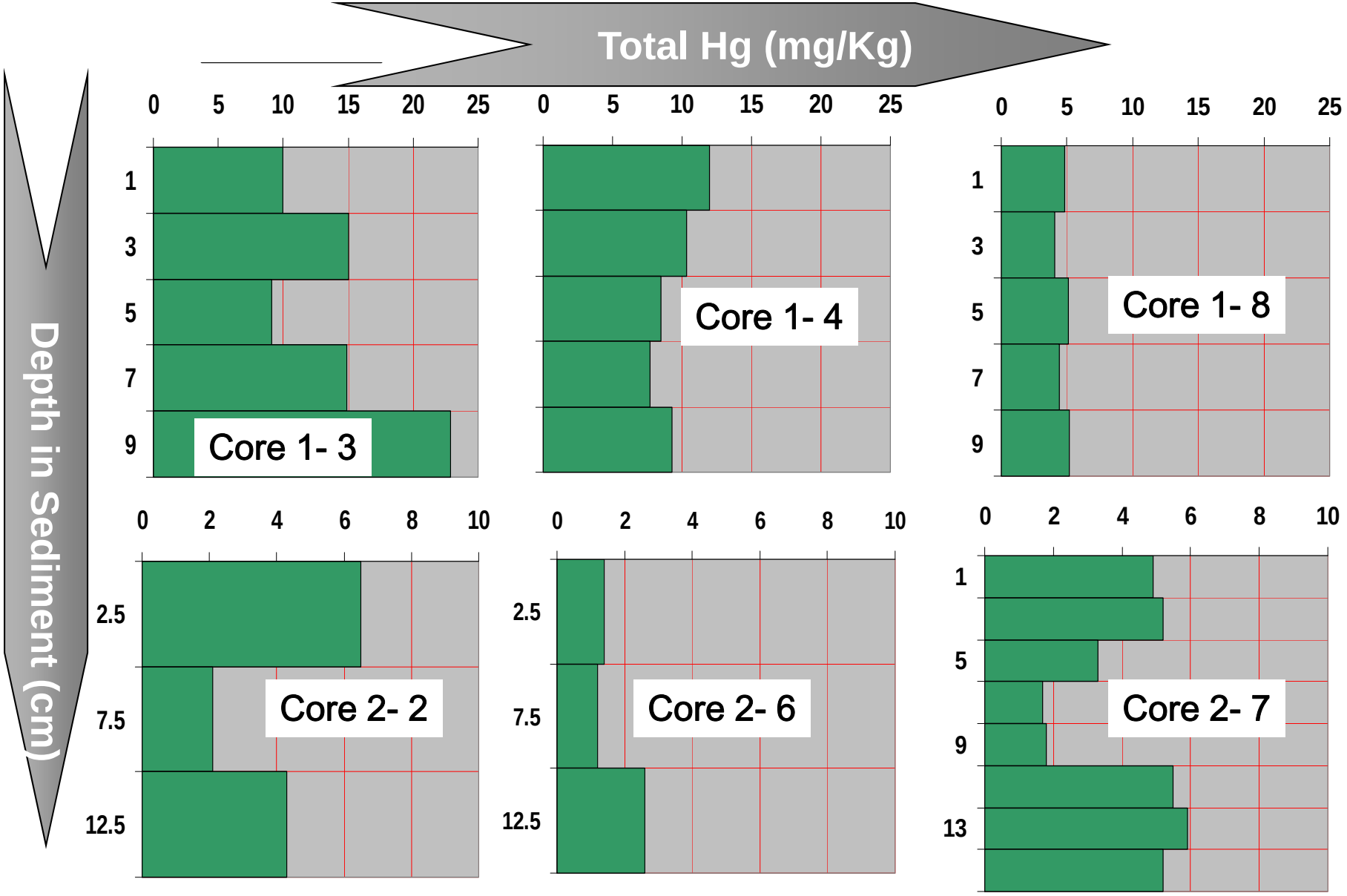
Site 2 (Tributary) – Core 2

- Uppermost site on tributary
- Surface soils are dry and covered with vegetation
- Core collected by driving with mallet

- Note significant decrease in Hg total above ~ 59 cm



Hg Total in Surficial Sediments

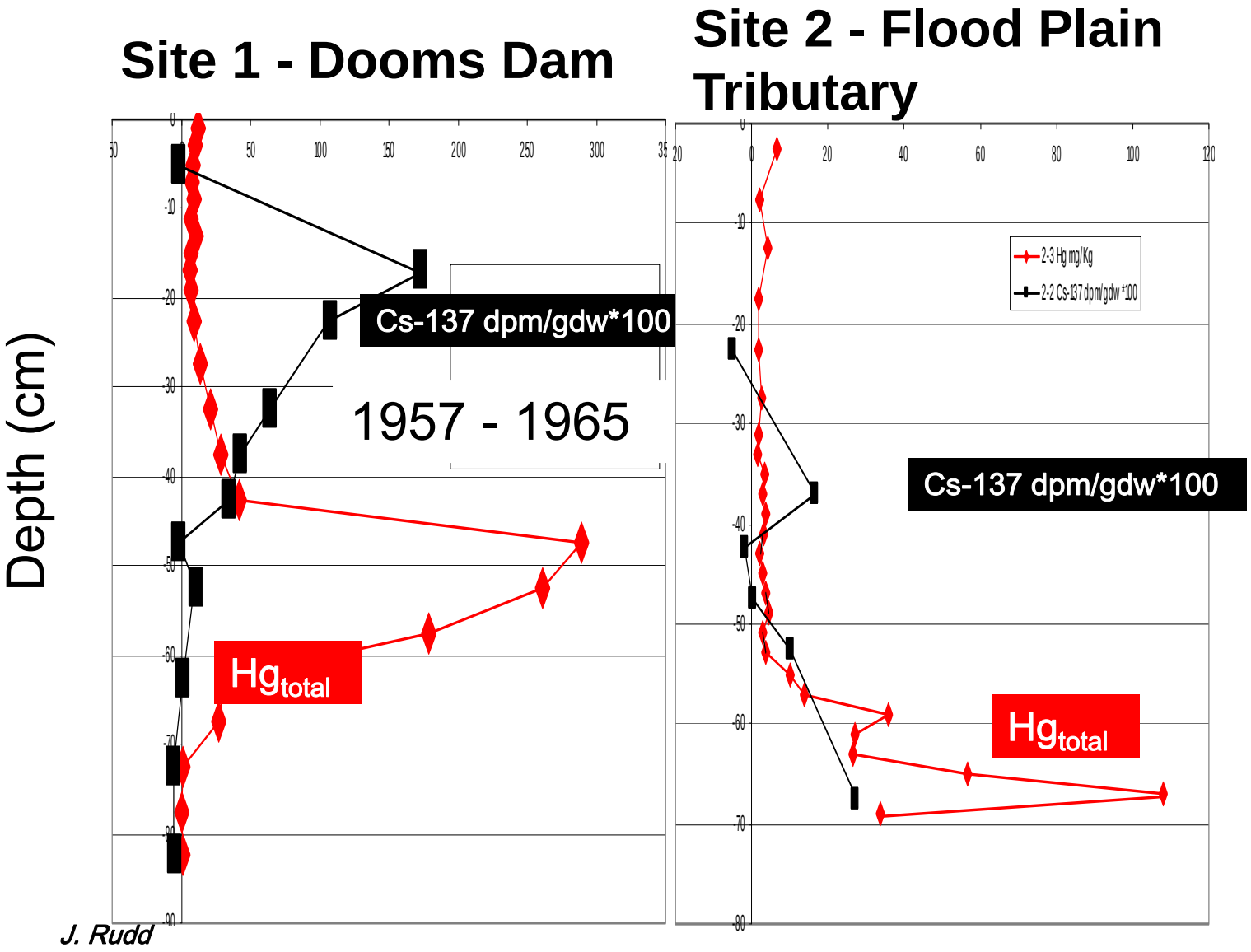


Cs-137 and Pb-210 Isotope Analyses

http://www.flettresearch.ca/Webdoc4.htm

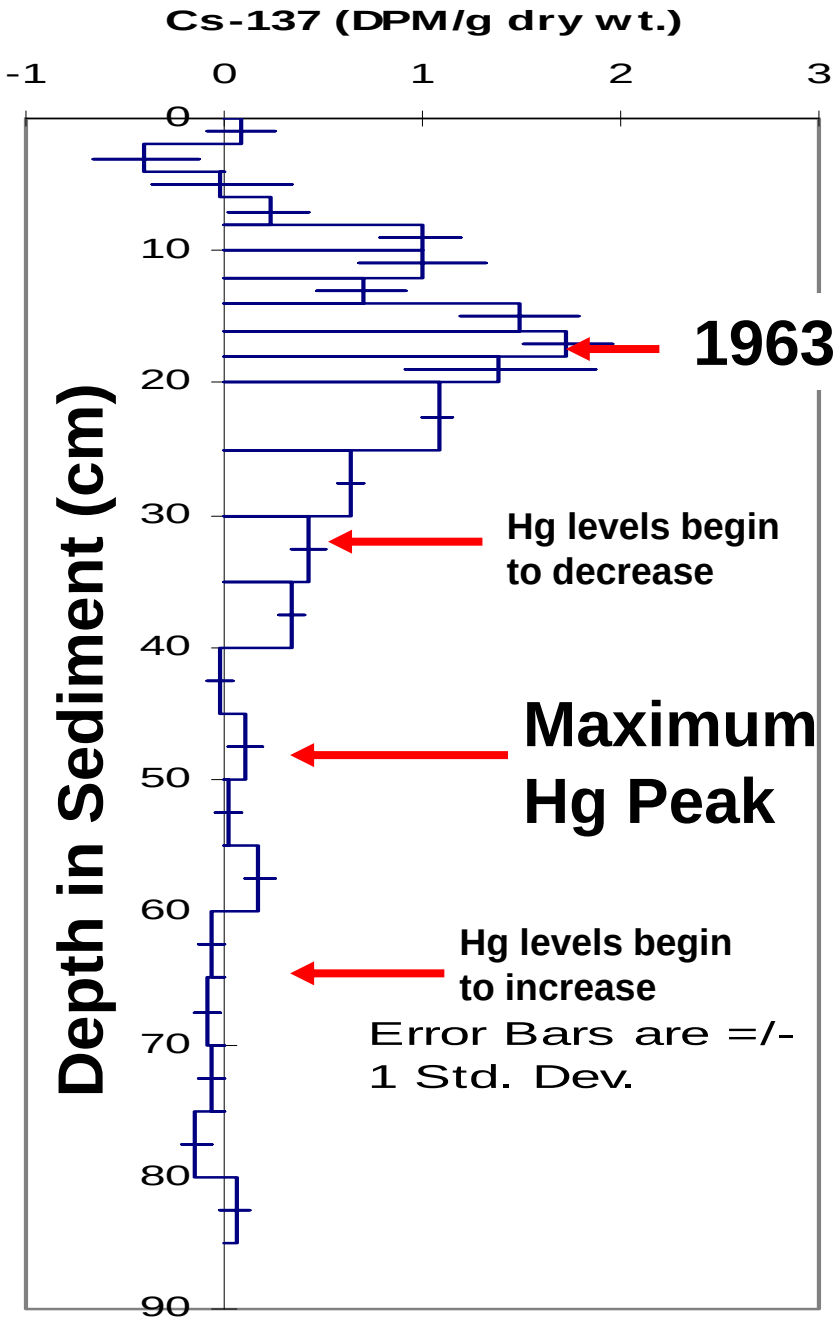
- Depth Profiles of Cs-137 and Pb-210
  - Sediment dating
  - Sediment accumulation
  - Mixing w/in sediment column
- Cs-137
  - Source: atmospheric deposition as a result of nuclear bomb testing.
  - Peak fall-out was in 1963.
- Pb-210
  - Two Sources:
    - Decay product of Ra-226 naturally present in soils (“Supported”)
    - Atmospheric deposition (“excess or unsupported”)
  - Analysis:
    - Half-life of Pb-210 (22.3 yrs)
    - Conc. of unsupported and total Pb-210 w/ depth.
    - Assumes constant supply of unsupported Pb-210

Cs and Hg_{total} Data: Core 1-4 and 2-3/2-2



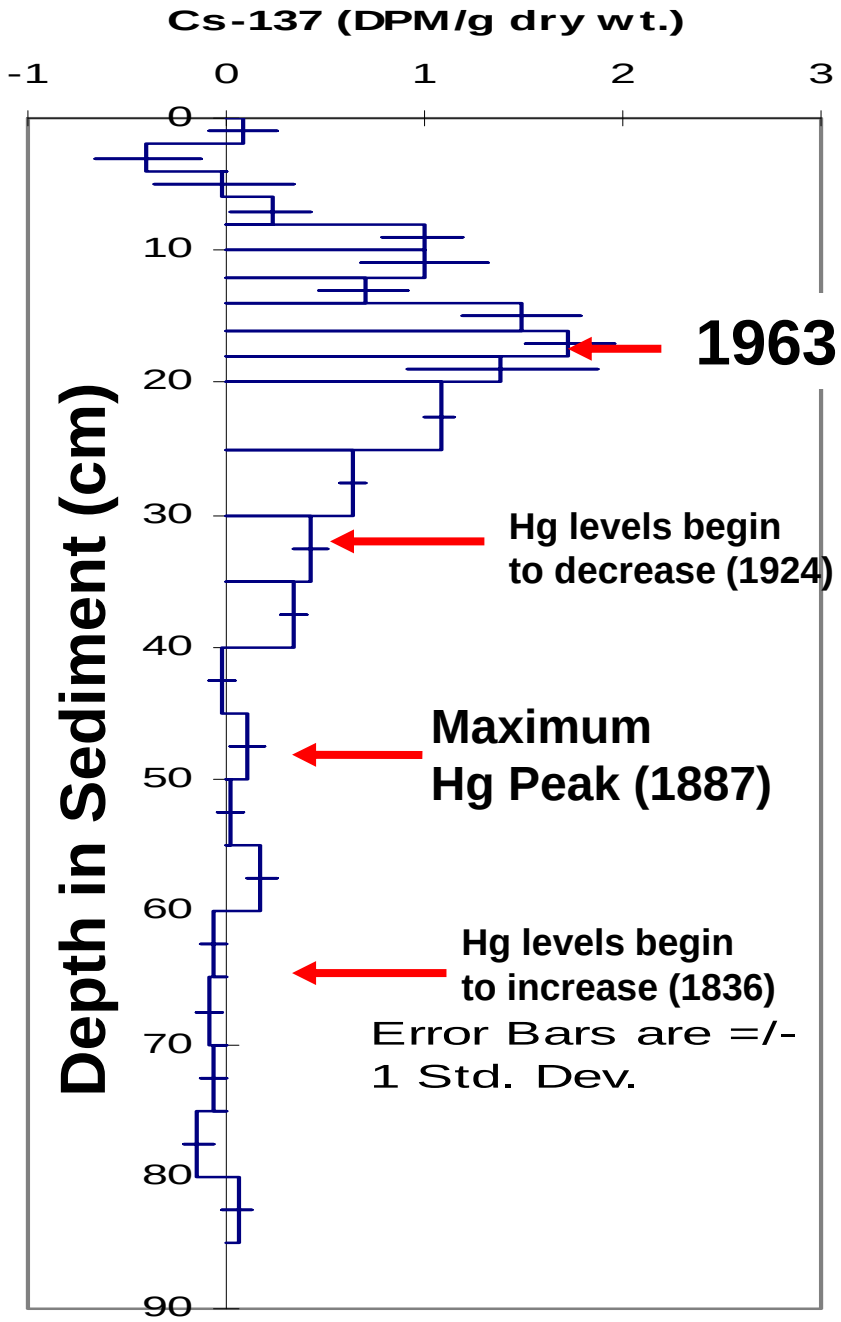
Completed Cs-137 Profile for Core 1- 4

- Cs-137 data
  - Hg inputs occurred before 1963.
  - Predicts sedimentation rate of 0.246 g / cm^2 /yr (or about 0.43 cm/yr)
  - Sediment mixing depths are short.



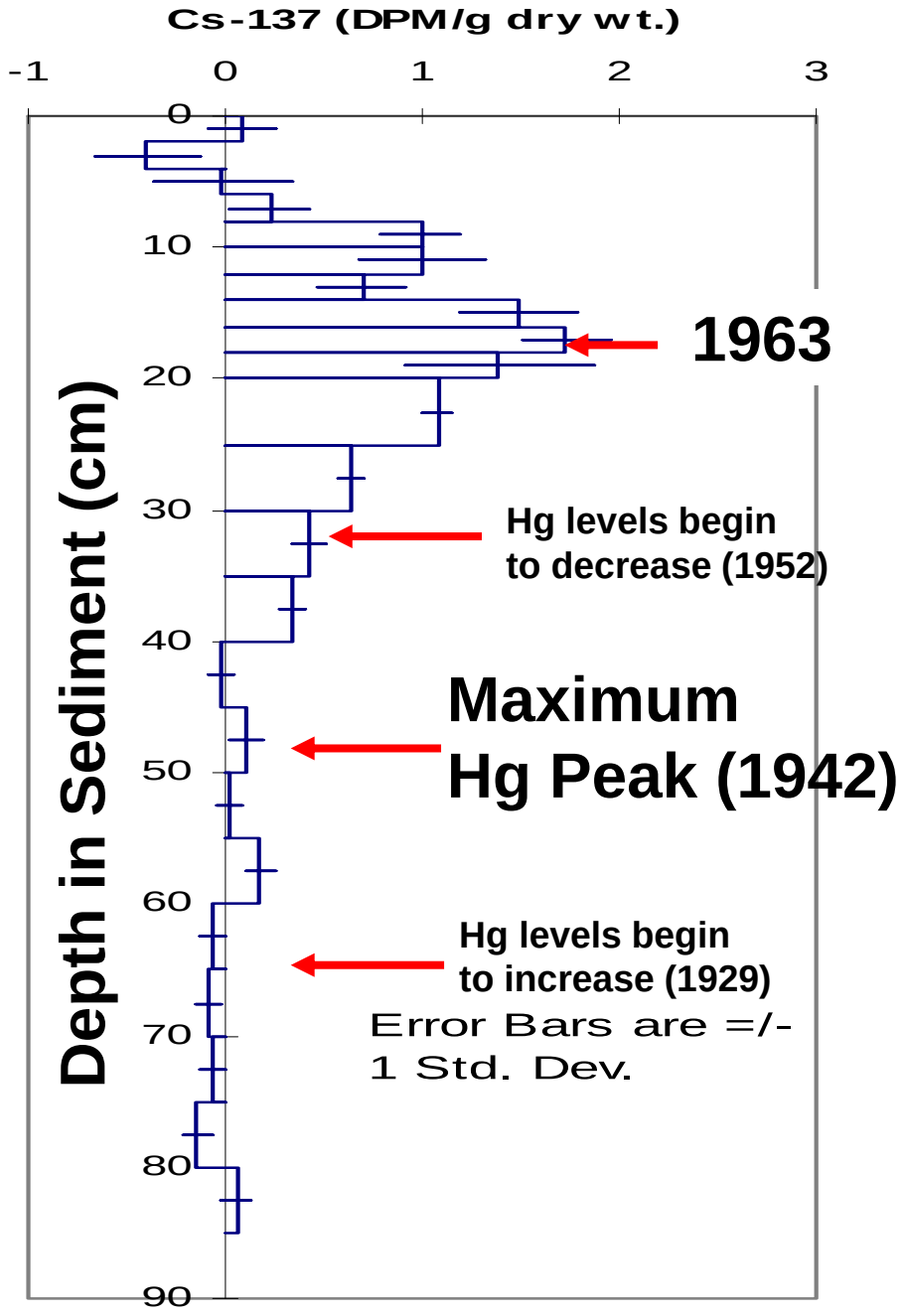
Chronology Using Cs 137 Only

- If 17 cm deep = 1963 then 0.25 g/cm^2/yr or ~ 0.4 cm sediment /yr
- However this implies Hg increases began in early 1800's (too early)
- Less sediment deposited after 1963 than expected.
- Different sedimentation rates over time? Or core does not represent 1963-2002 deposition?



Chronology Using Pb - 210 and Cs-137 Results

- Pb-210 data (not shown)
  - Exponential decrease in Pb-210 with depth (as expected).
  - Pb results predict higher sedimentation than Cs results (0.54 - 1.2 g/cm^2/yr or 1.0 - 2.3 cm/yr)
  - Pb and Cs Results are in agreement if it is assumed that 43 cm of deposition after 1963 is not represented.
    - Sedimentation is ~1.5 cm/yr
  - With Pb data, and assumptions, Cs and Hg data agree with known history.



Observations

- Evidence of historic releases of Hg, followed by deposition of cleaner sediments.

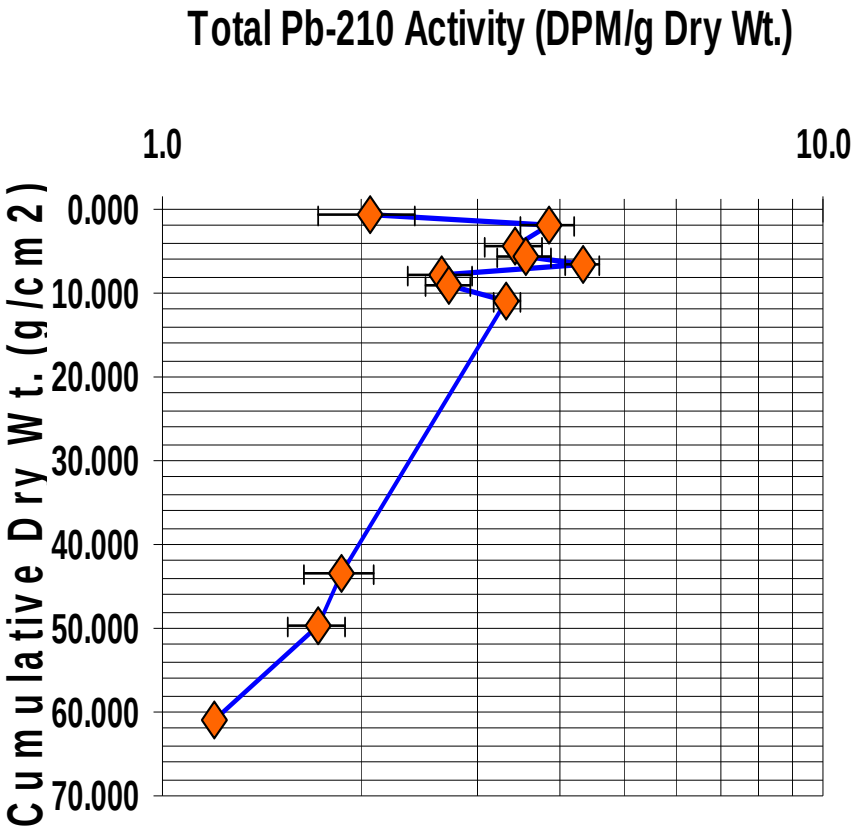
- Hg in surficial sediments (top 10-15 cm) is elevated relative to deepest sediments and to sediments upstream of the plant
  - Isotope data suggests that cores do not represent deposition between 1963 and 2002
  - Surficial sediments in all cores were 5-10 ppm Hg
  - Water column data is consistent with 5-10 ppm Hg in surficial sediments

- Estimated sedimentation rates range from 0.4 to 1.5 cm/yr

- Evidence that historic releases were pre-1960's (consistent with our history). Combined isotope data is consistent with expected historical dates for period of Hg release.

Pb- 210 Analysis Results Core 1- 4

Total Pb-210 Activity vs. Accumulated Sediment



Regression of Unsupported Pb-210 Activity vs. Accumulated Sediment Using Background = 0.6540 DPM/g