

Mercury in Cores from San Francisco Bay and Wetlands

RMP Annual Meeting 2009



Core – What Is It Good For?

America's largest core?



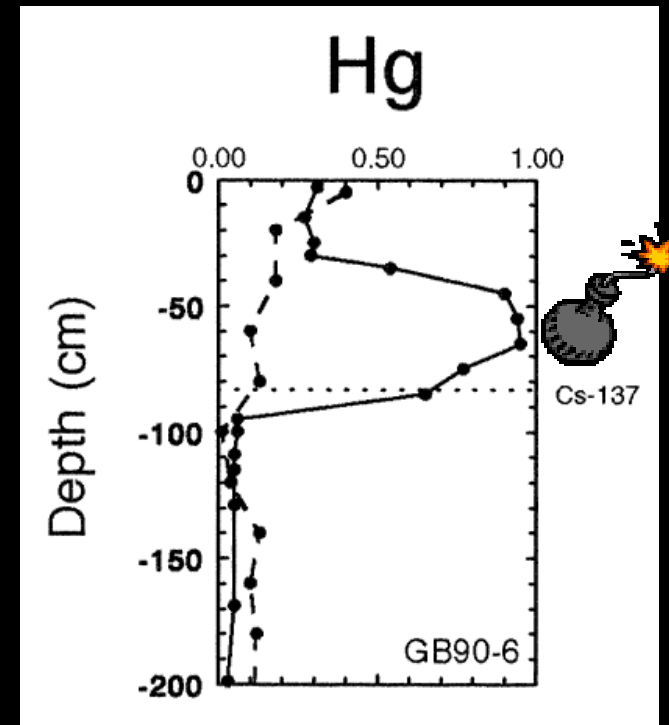
SF Bay core to scale >

A History of sediment

Even when not neatly stacked, a history of process

SF Bay - Cored Before

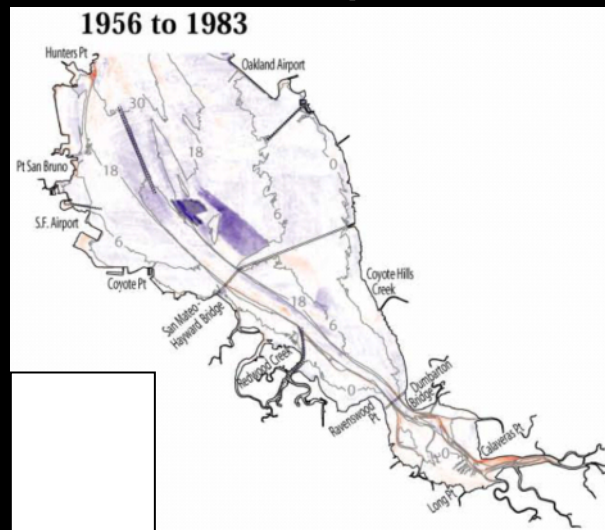
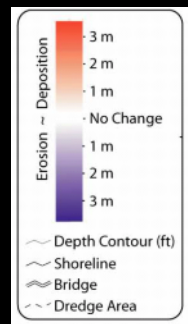
- USGS (1990) cores
 - 90+ sites screened only
 - 2 depositional sites in detail
 - Polluted max subsurface
 - Pollutant reservoir
 - Much of SF Bay eroding
 - Ticking TIME BOMB?!!!



Hornberger 1999

Why Recore?

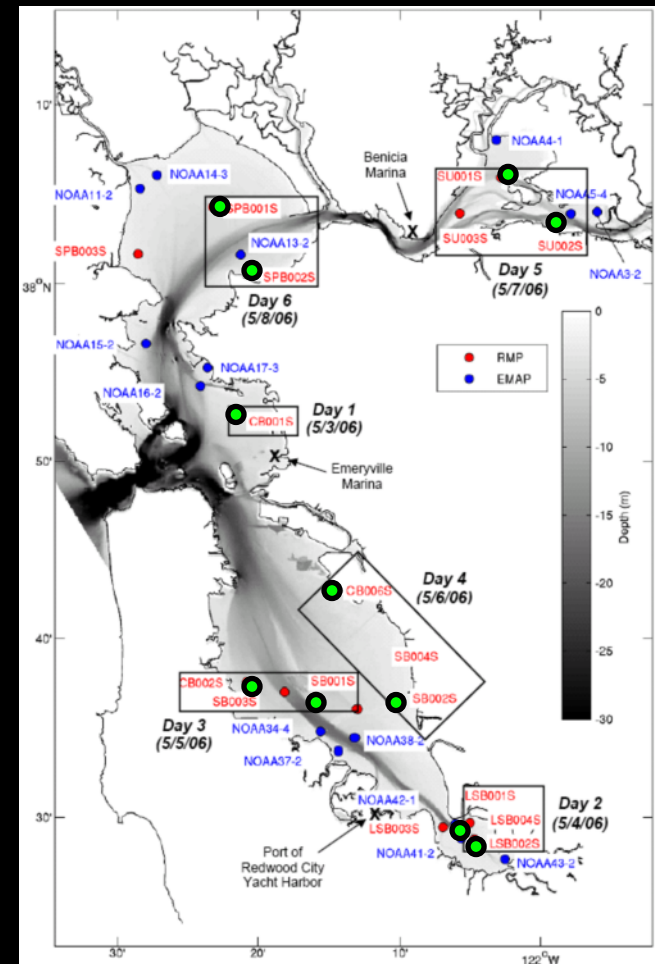
- Need baywide inventory to predict trajectory
 - 2 of 90+ sites probably not representative
 - Much of Bay erosional, not depositional (Jaffe et al)



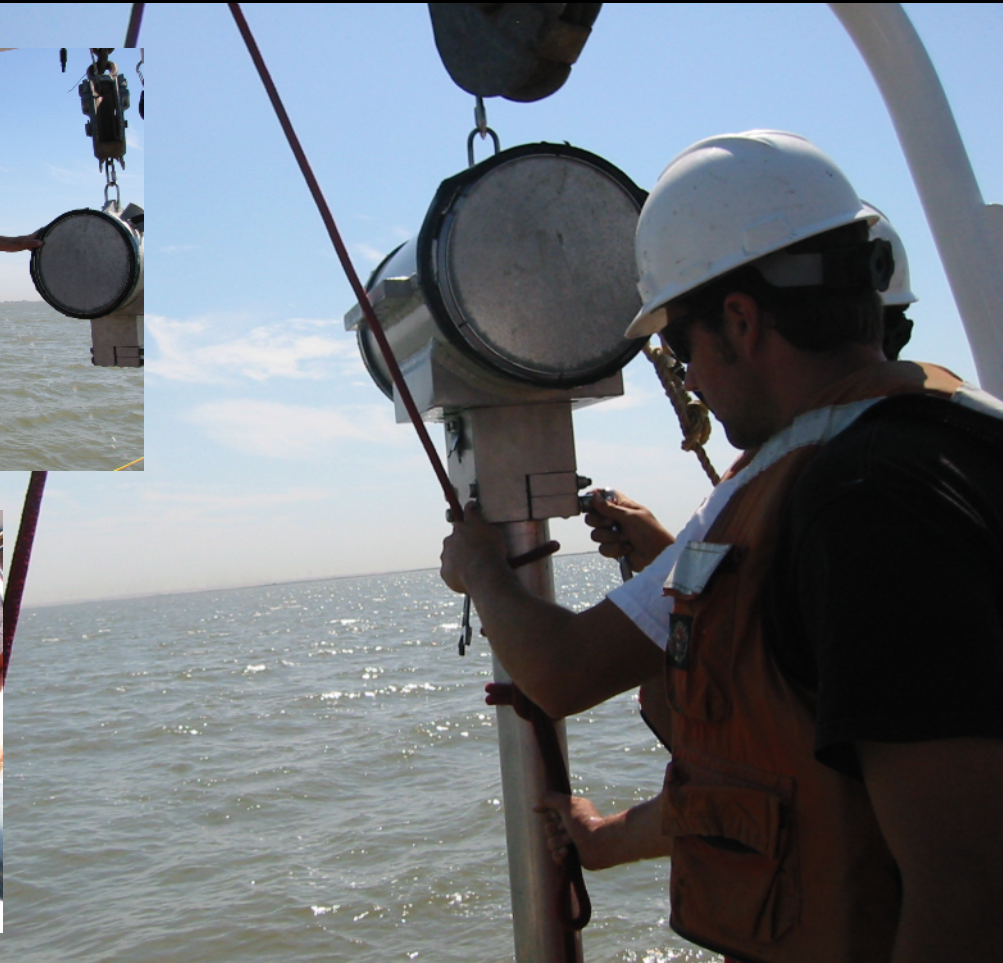
- Use those previous 90+ cores?
 - Old, unusable for chemical analyses

11 Bay (Underwater) Sites

- Random, representative (inventory, processes)
 - 3 sites Central Bay,
 - 2 each other segments
 - Mostly RMP annual repeat stations

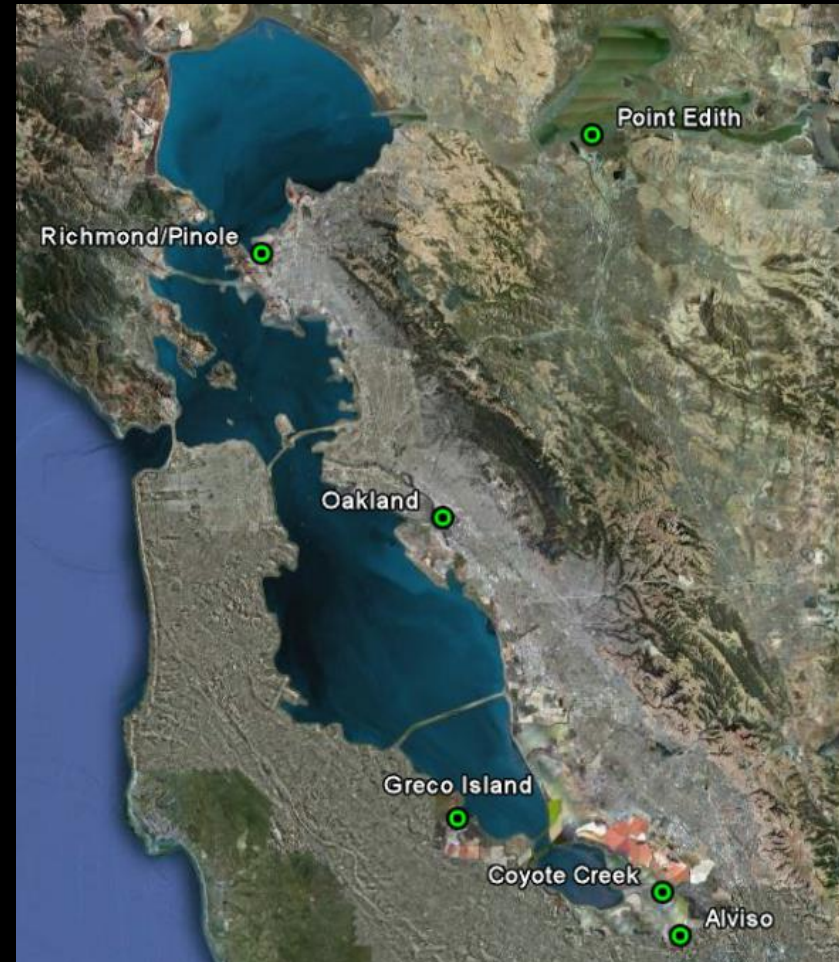


Bay Vibracoring



6 Wetland Sites

- Loading history
 - Depositional zones
- 1 site each segment
 - Pt Edith (Martinez)
 - Wildcat (Richmond)
 - Damon Sl. (Oakland)
 - Greco Island (R.C.)
 - Coyote Creek (S.J.)
- + Alviso Marina (for New Almaden)



Wetland Piston Coring



What Did We Expect?

- Pollutant distribution - function of
 - Local land use/pollutant loading
 - Sediment process history
- Sedimentation rates and dates
 - Similar in segment (shared water, sediment)
 - Mid-scale differences (source proximity, etc)

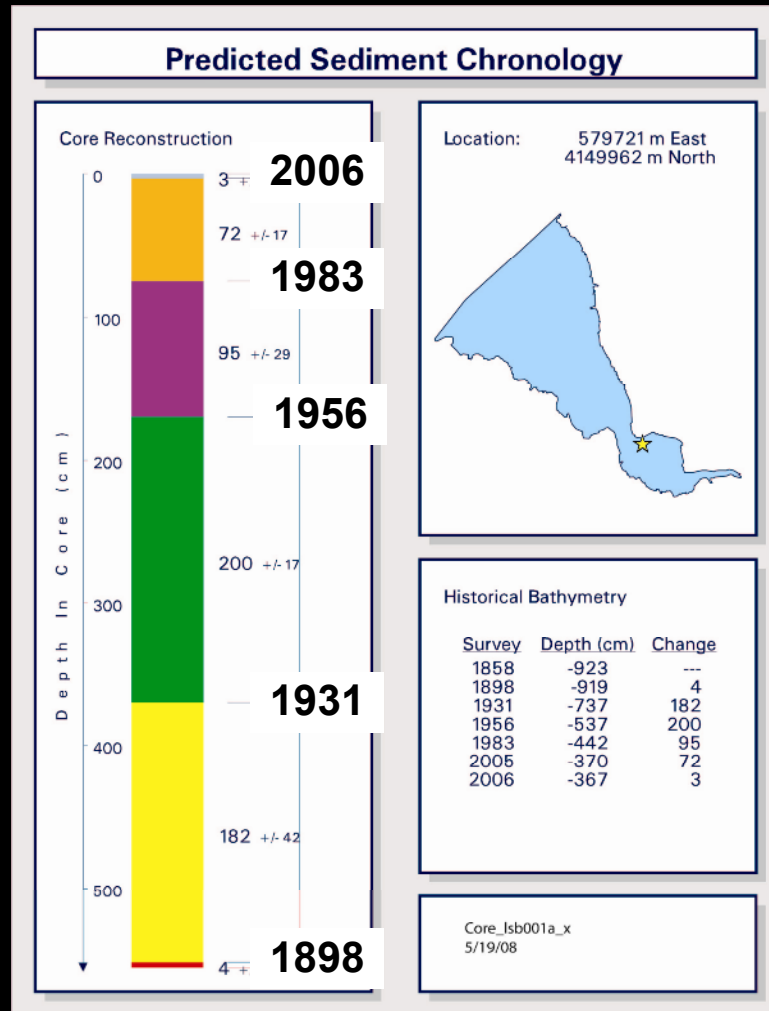
- How do we get dates for core sections?

Date A Core

Core # 3: How old
are you?



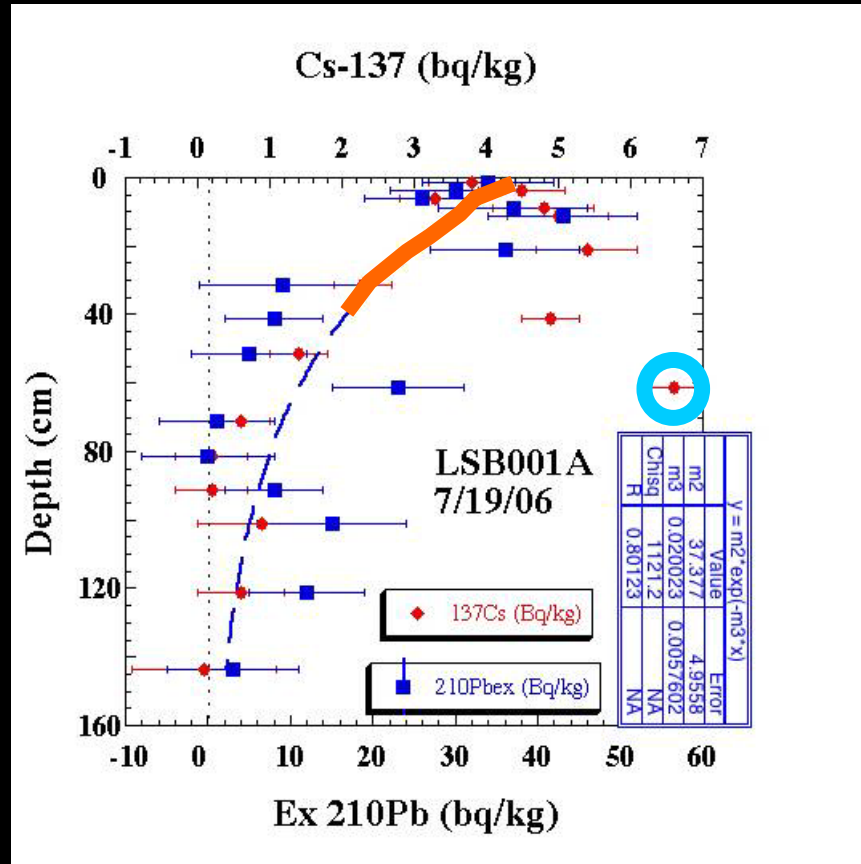
Dating: Bathymetry



(USGS Bruce Jaffe)

- Net bathymetric change between surveys
 - + deposition – erosion
- Some sites depositional & erosional different periods

Dating: Radioisotopes



(USC Hammond)

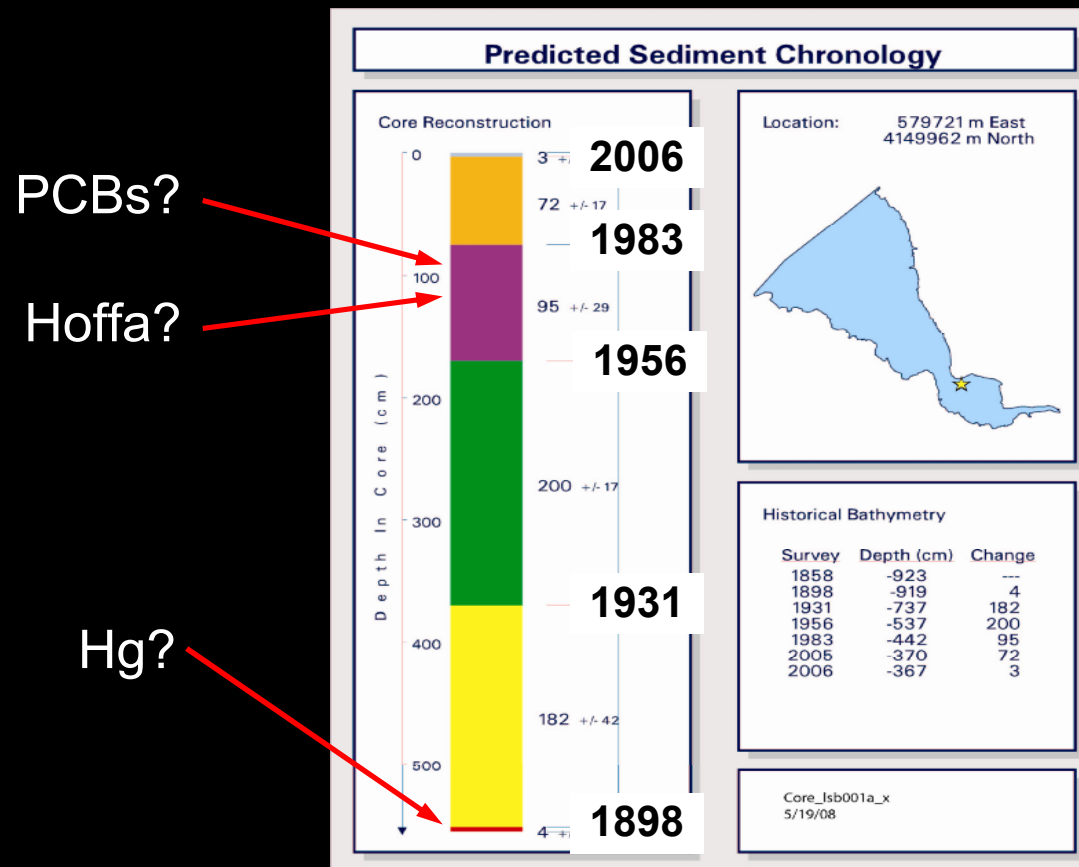
- ^{137}Cs in atom bomb
 - Post ~1950
 - Max ~1960
- ^{210}Pb decay
 - Half life 22 yrs
 - Decay/dilution can look similar
 - If Cs & Pb similar, likely dilution

Dating Results

- Sites within segments similar
 - Suisun, San Pablo erosional
 - Central, South neutral/erosional
 - Lower South depositional
- Radiodating/bathymetry results similar
 - Not perfect matching given spatial variation/resolution of bathymetry

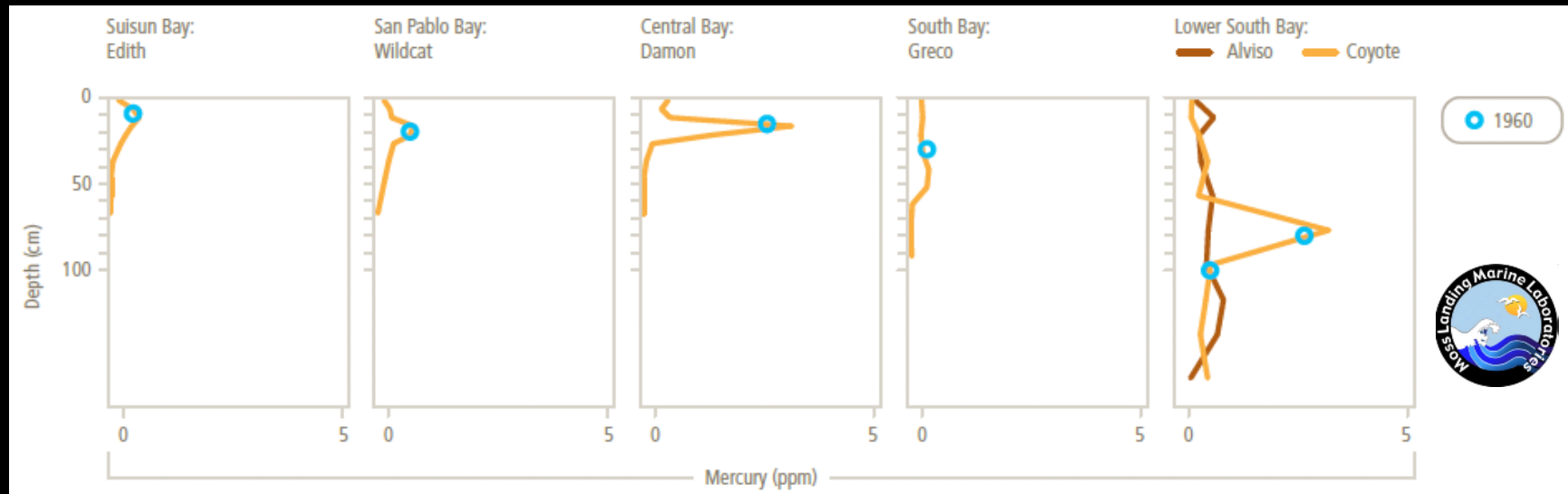
Digging Into Our Dirty Past

- Age of layer → hints what you might find



Our Dirty Past: Mercury

- Max in wetlands ~1960 or a bit earlier



1960 estimated by ^{137}Cs

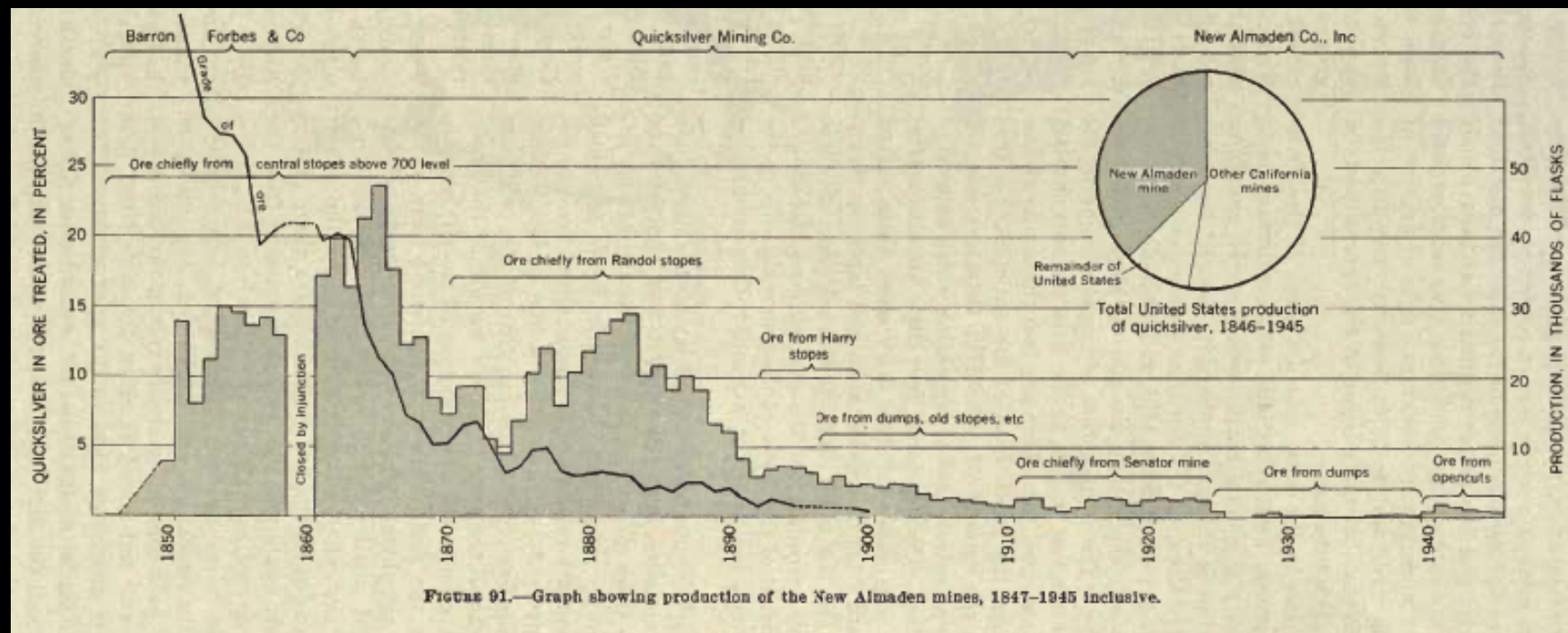
- Where is the mercury from?

Blame... New Almaden?



Is It Really From Mining?

- New Almaden mining max late 1800s

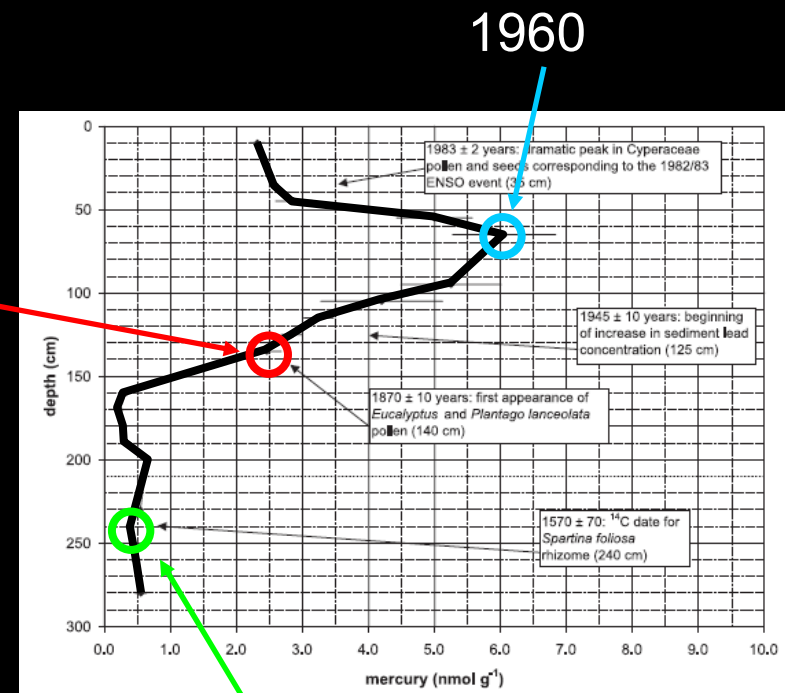


Not-So-Quicksilver?

- Mine Hg starts high in watershed, could....
 - take a while to get down
 - still be up there

or...

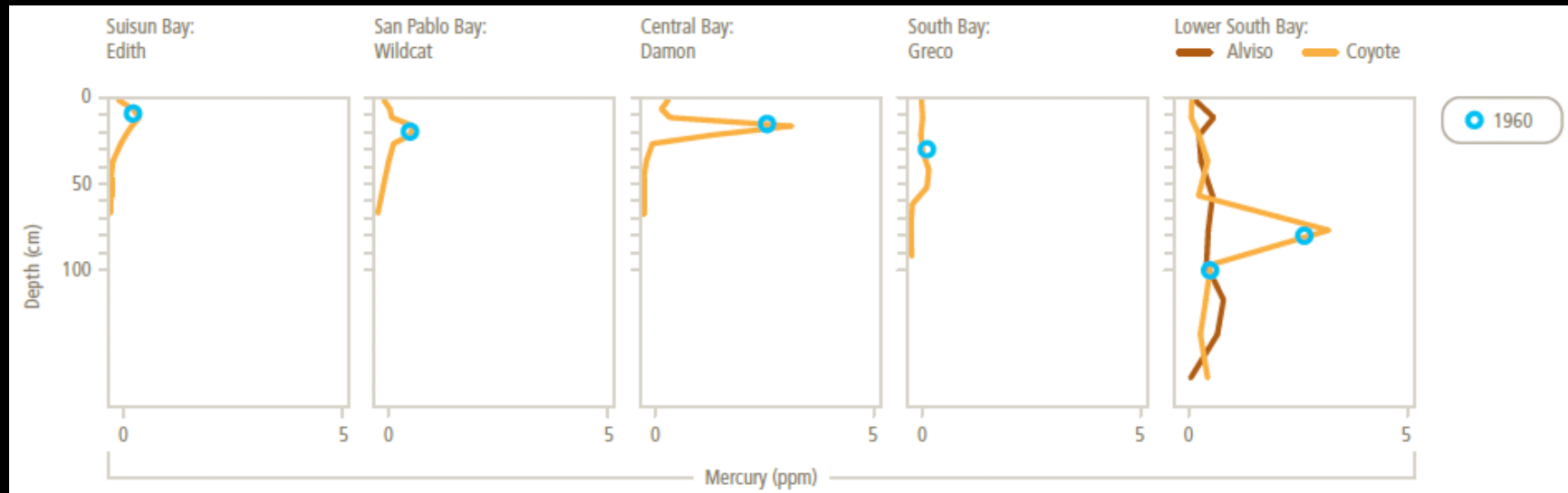
- cores too shallow?
 - NO, 1870 < 1960 near Coyote in previous study



Conaway 2004

Mines in Oakland??

- If 1960 max from mining, why is Oakland (CB) ~ Coyote (LSB) > SB, SPB, SUB

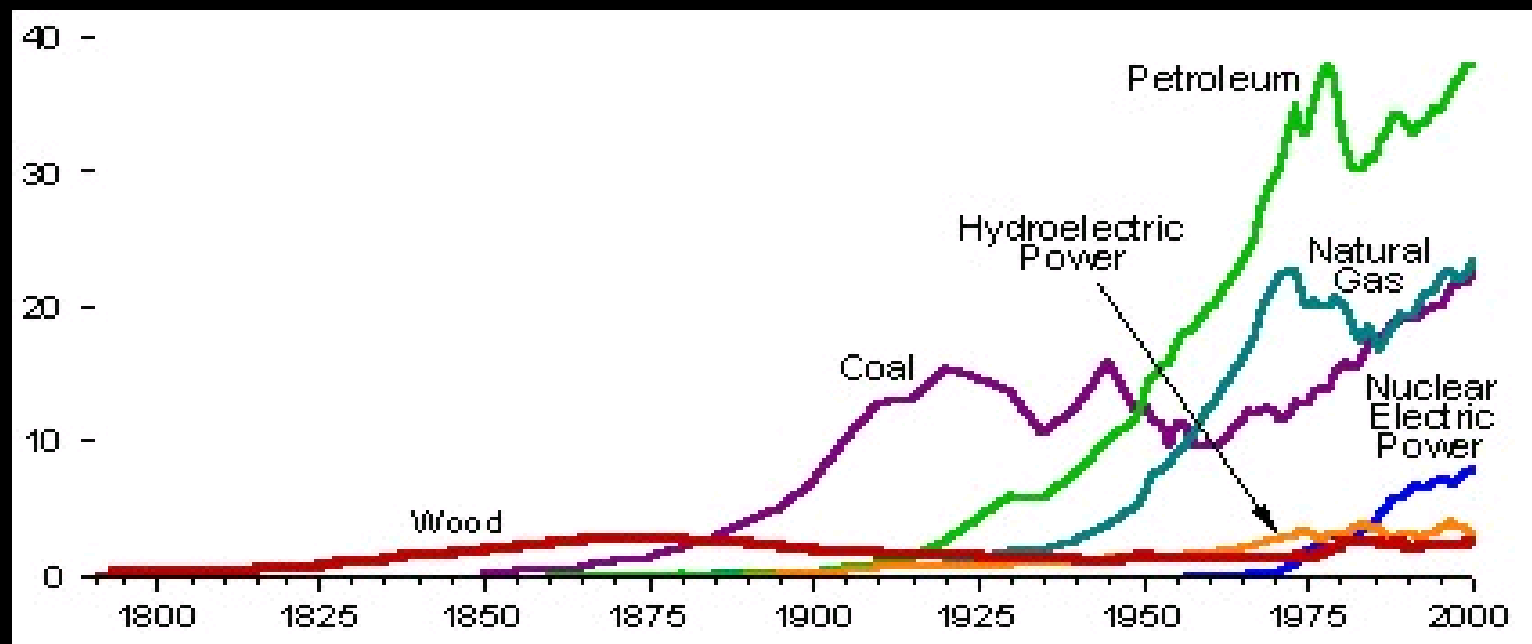


- Alternative hypotheses?...

Old King Coal?

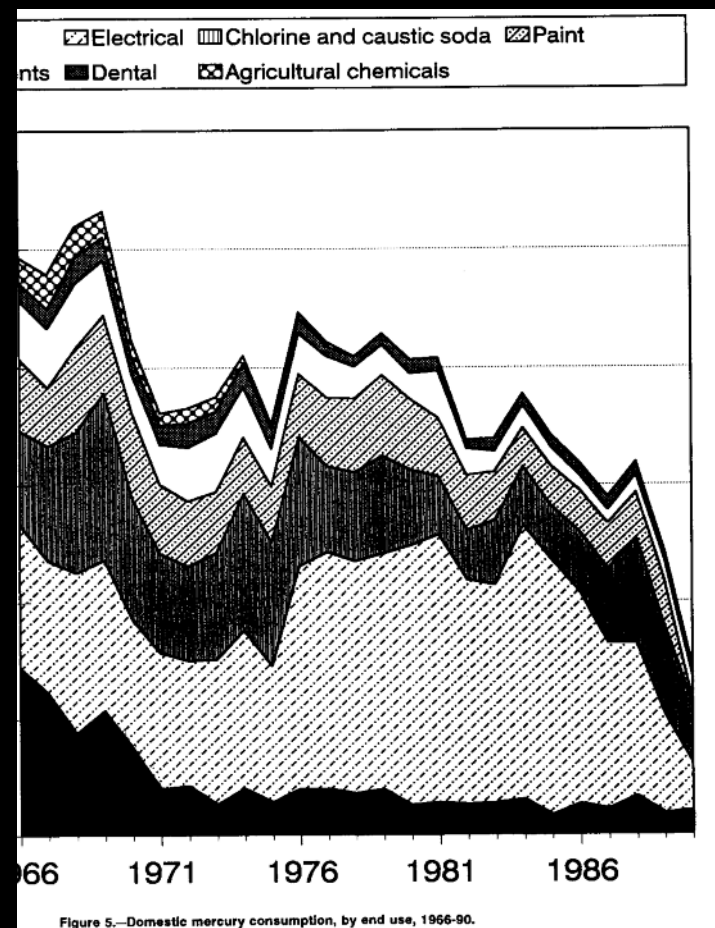
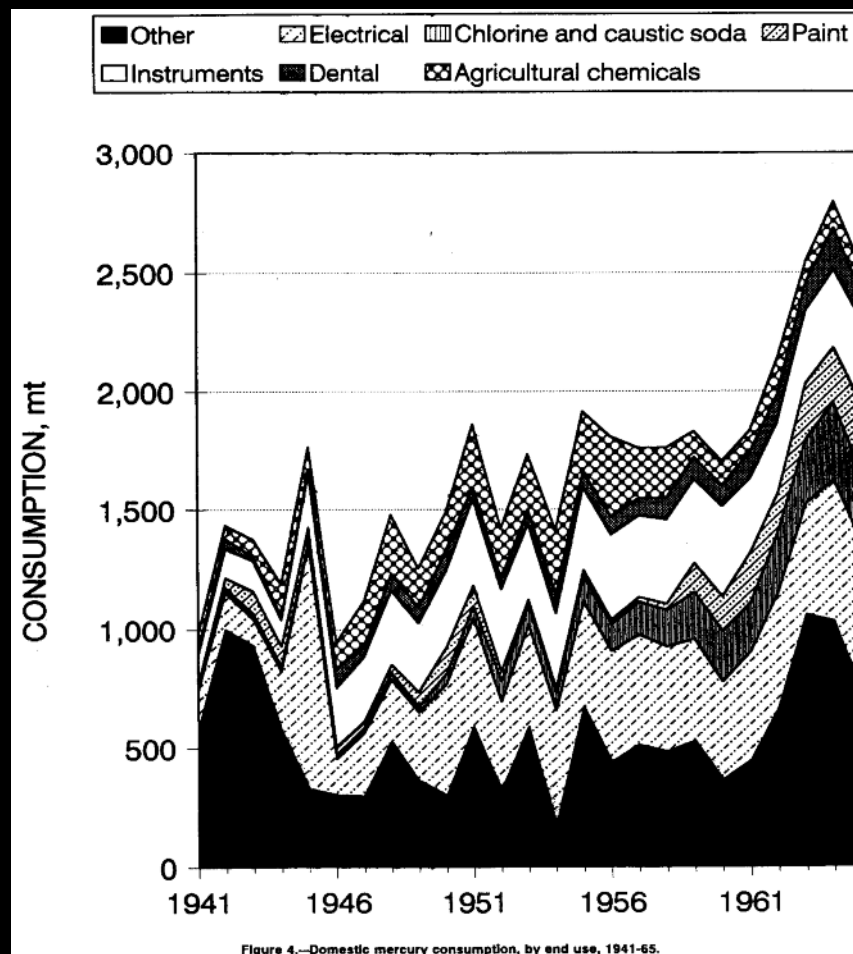


- Urban residential/industrial sources
- Temporarily peaked in 1940s
 - post 1970s use better emissions control



U.S. Dept of Energy

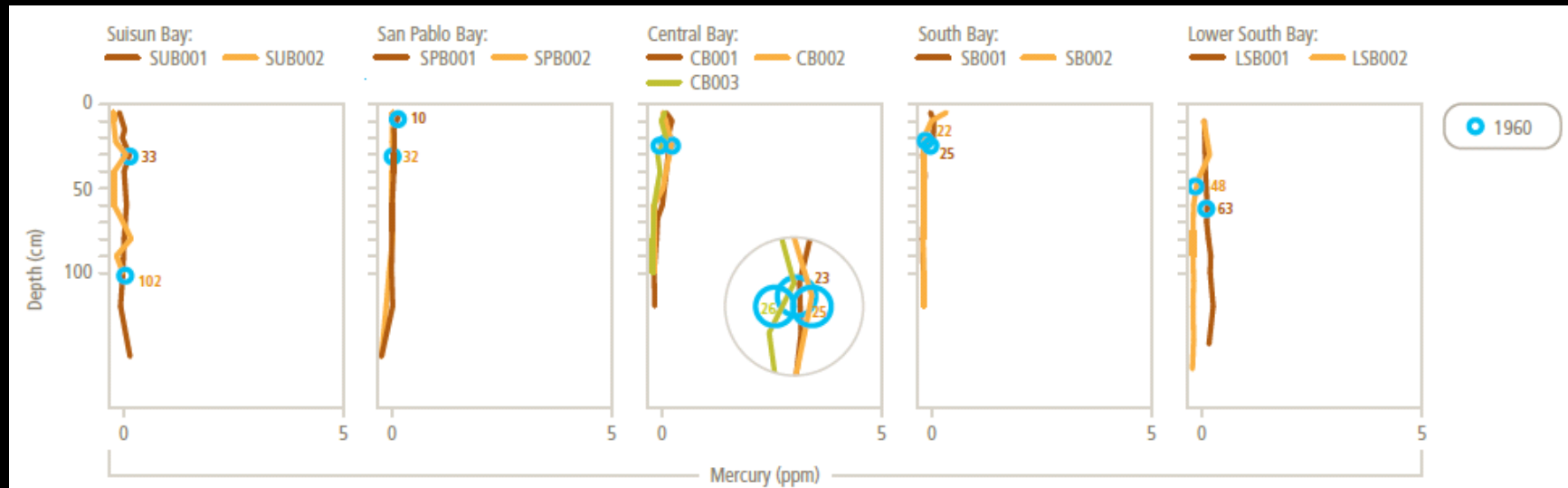
Industrial Use Max 1960-1970



US Bureau of Mines 1994

Same Patterns in Bay?

- Mostly not- comparatively flat, but deepest sections lower in Hg.



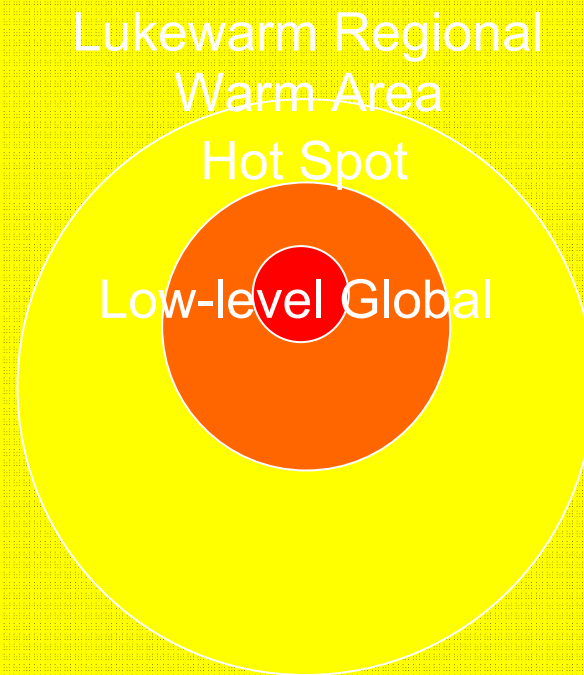
Good News / Bad News

- Good news-
 - Few nasty surprises in Bay (only 4 of >100 sites have large subsurface max)
 - Mostly near current surface concentrations
- Bad news-
 - Not for lack of/constant sources
 - wetland cores show otherwise

Where have all the time bombs gone?

Long Time Passing?

- Dispersion processes spread pollutants
- Dilution to “safe” levels slow, if ever



Proverbs Re-Learned

Don't wait until the horse has bolted to close the barn door.

A stitch in time saves nine.

Turn off the faucet before mopping the floor

An ounce of prevention is worth a pound of cure.

B. Franklin

An ounce of prevention
is worth a TON of cure.

$$27.8 \text{ g/oz} \div 0.23 \text{ mg/kg} = 118 \text{ metric tons}$$