# The Southern California Bight Regional Monitoring Program:

## *Extending Local Monitoring to Understand Large Scale Sources, Fates and Effects*


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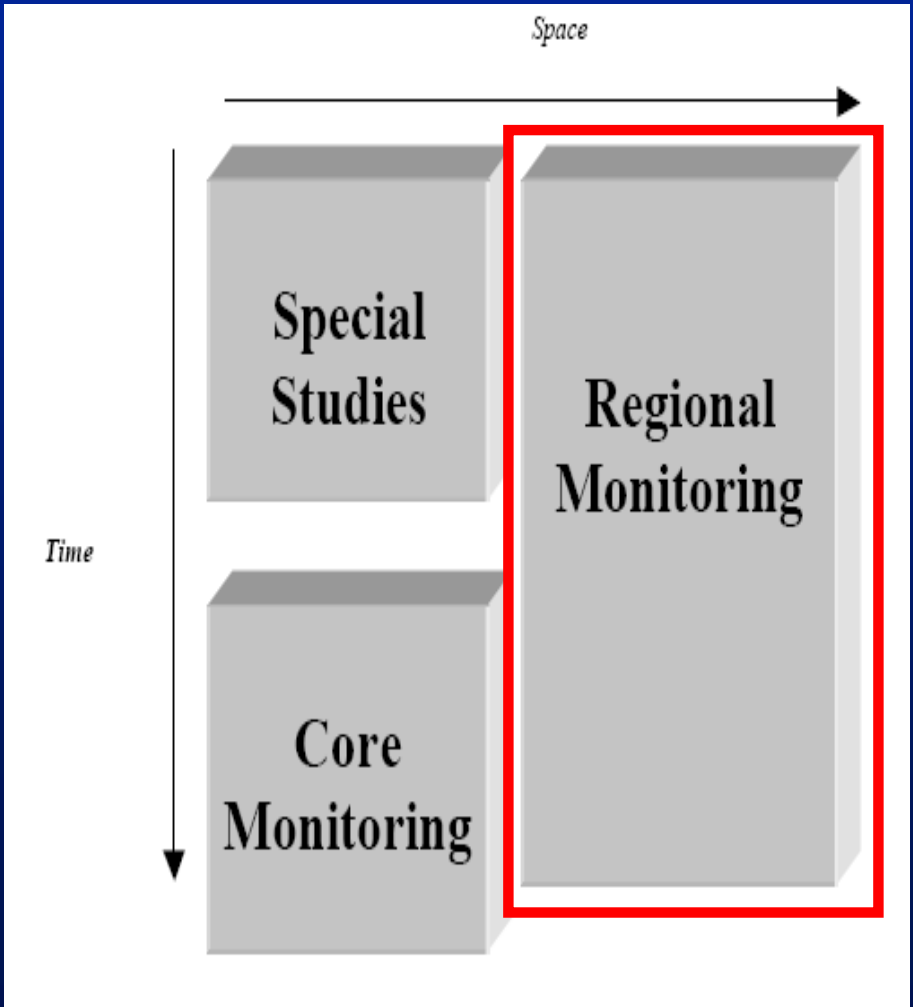
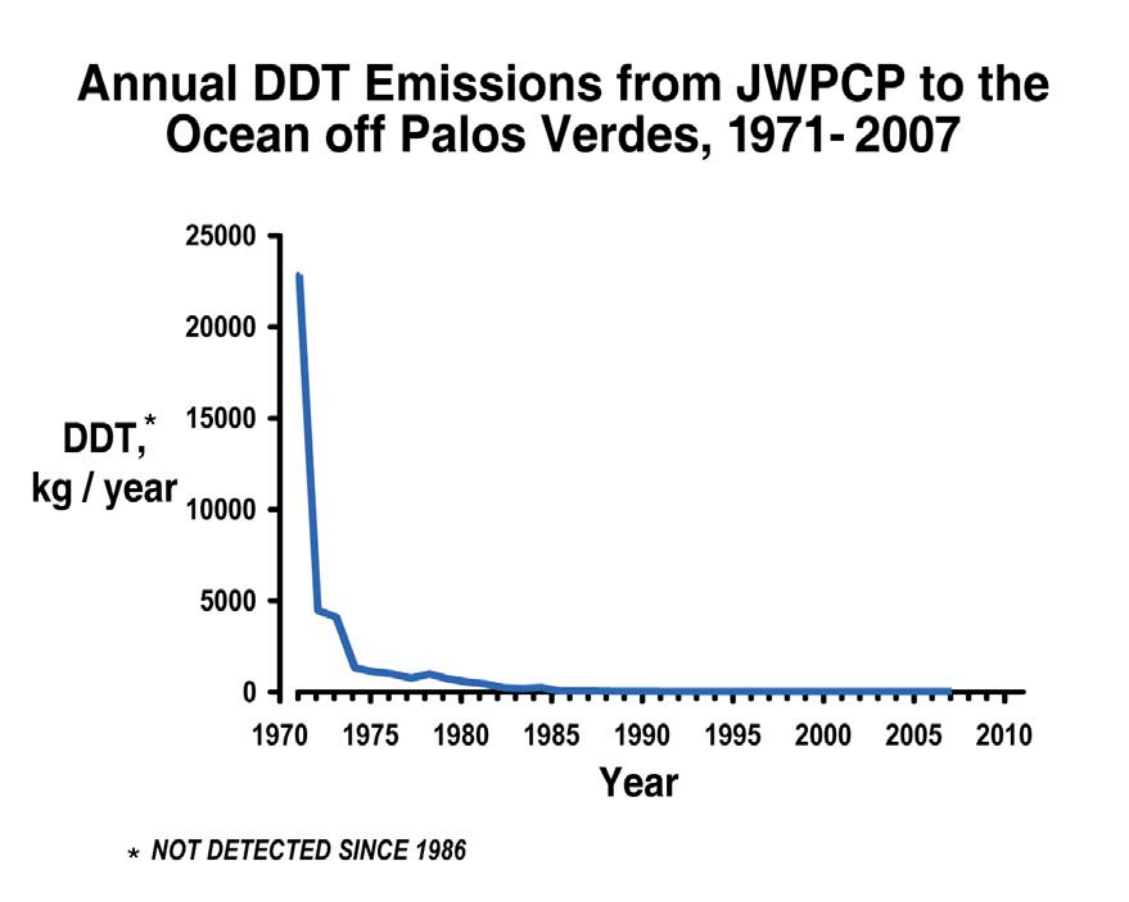
# Why Regional Monitoring?

- Provide context to local (core) monitoring results
  - Range of impacts from all sources
  - Expanded view of reference conditions
  - Influence of natural events
- Method development and intercalibration
- Key component of Southern California Model Monitoring Program
  - Provides coherent structure to address questions of concern in an integrated manner

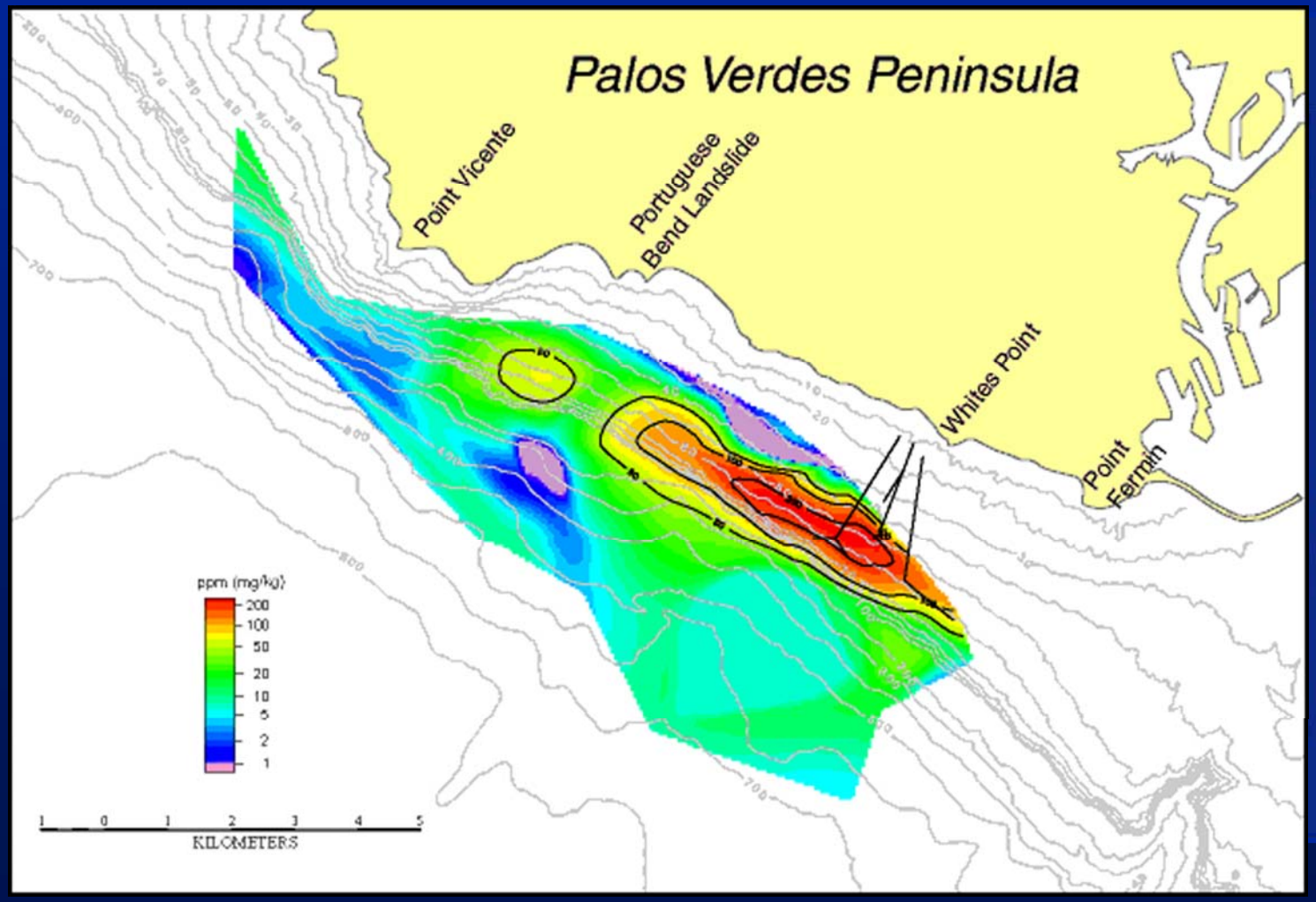


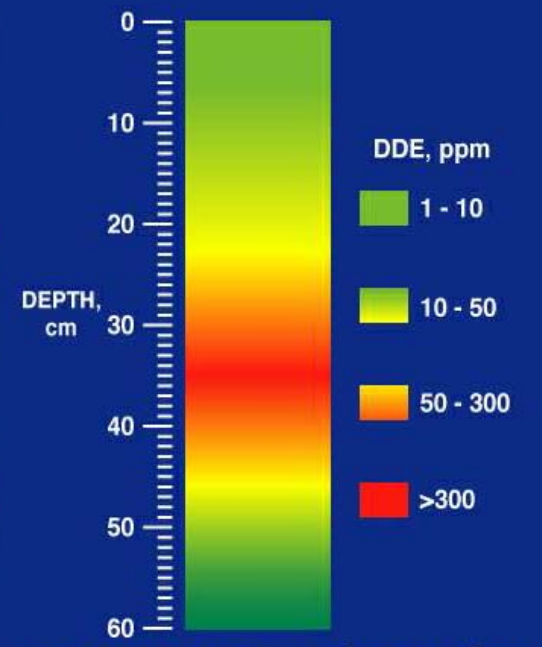
# Case Study: DDT Mass Balance

- Manufactured in LA from late 1940s to early 1980s
- Connected to LACSD sewer until 1971
  - Estimated discharge to Palos Verdes Shelf (PVS) = 1,800 metric tons (MT)
  - 200 MT estimated in PVS sediments in 1974
- Ocean disposal
  - 600 metric tons (MT)
- Established PVS as Superfund Site in late 1990s



# Local Monitoring of the DDT Deposit




p, p' - DDE Distribution in Sediment Core Station 7C 1997

# DDT Mass Balance Questions

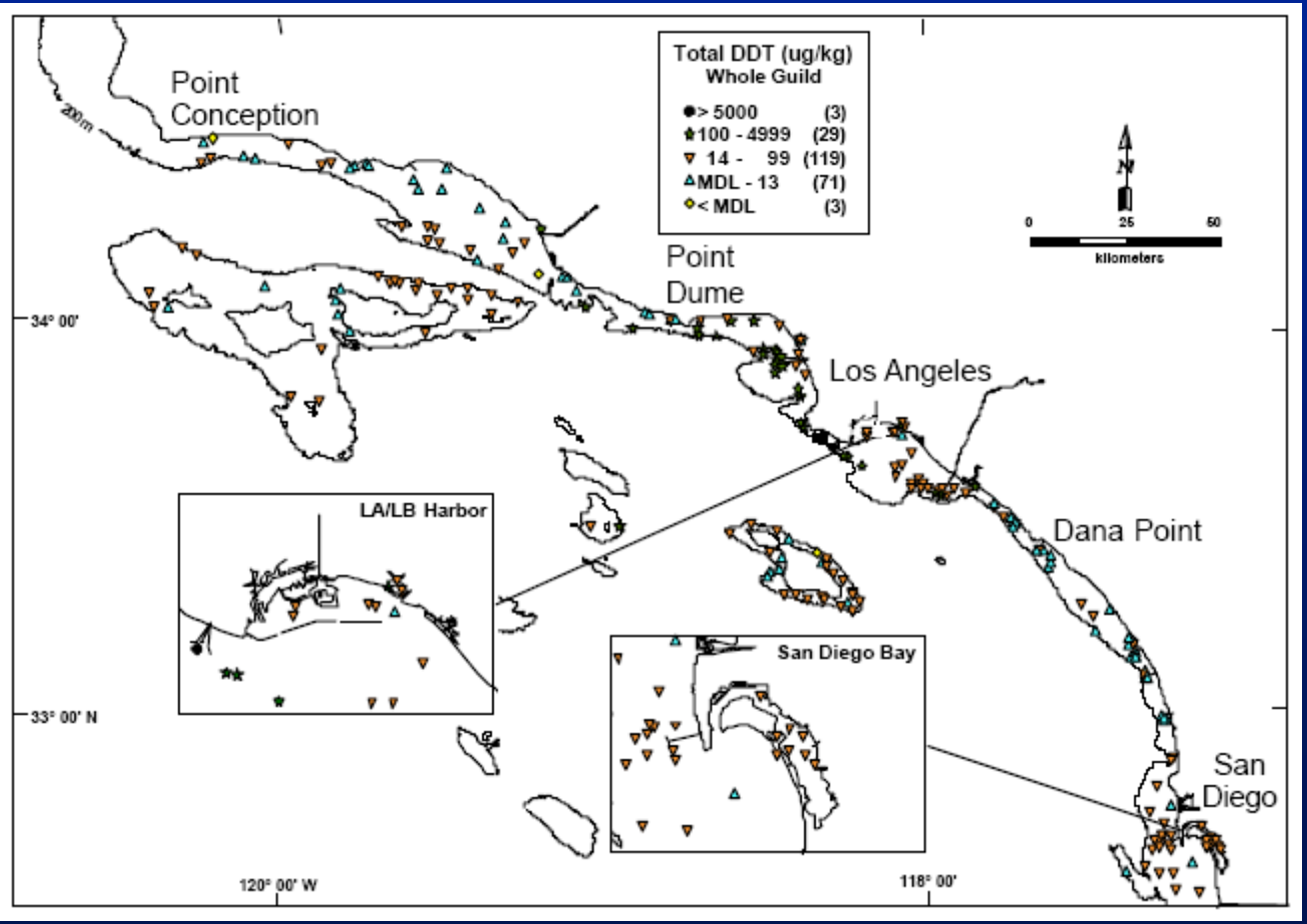
- What is the mass of DDT in the Southern California Bight (SCB)?
- How does the DDT mass compare among various environmental compartments?
  - Sediment, water, biota
- How does the mass compare to what we estimate was discharged?

# “Bight” and Other Studies Used for DDT Mass Balance Questions

- “Bight” monitoring studies
  - B’98 benthic fish survey
  - B’03 pelagic fish survey
  - B’03 LA margin sediment survey
- Other SCB studies
  - USGS cores of PV Shelf and Santa Monica Bay
  - SPME Water column surveys (Zeng et al., 1999)

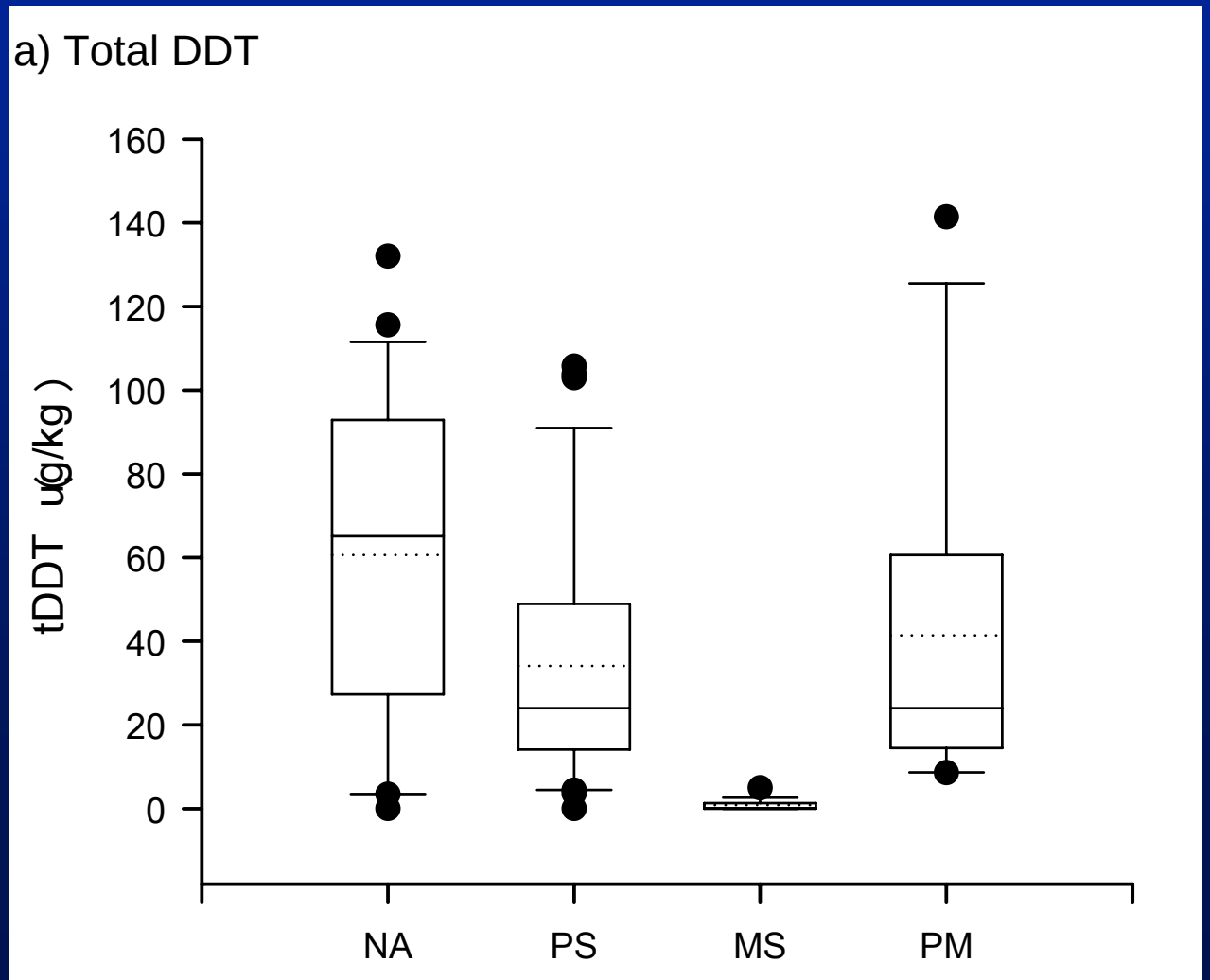
# DDT in Flatfish Guild (Bight'98)

- Targeted species w/highest exposure
  - 5 species of flatfish
- 225 sites sampled
  - Harbor to 202 meters
  - Whole body
- Widespread DDT contamination
  - 3 NDs (1.3%)
  - 67 % above wildlife risk threshold (14 μg/kg)
  - 13 % above (CA human health risk threshold (100 ppb)
- Total DDT mass estimated at <1 kg in this guild



# DDT in Pelagic Forage Fish and Squid (Bight'03)

- Targeted species
  - Northern anchovy (NA)
  - Pacific sardine (PS)
  - Market squid (MS)
  - Pacific mackerel (PM)
- Sampled commercial catch from fishing blocks within the SCB
- Only squid were below wildlife risk screening value (14 μg/kg)
- DDT mass estimate 1-25 kg

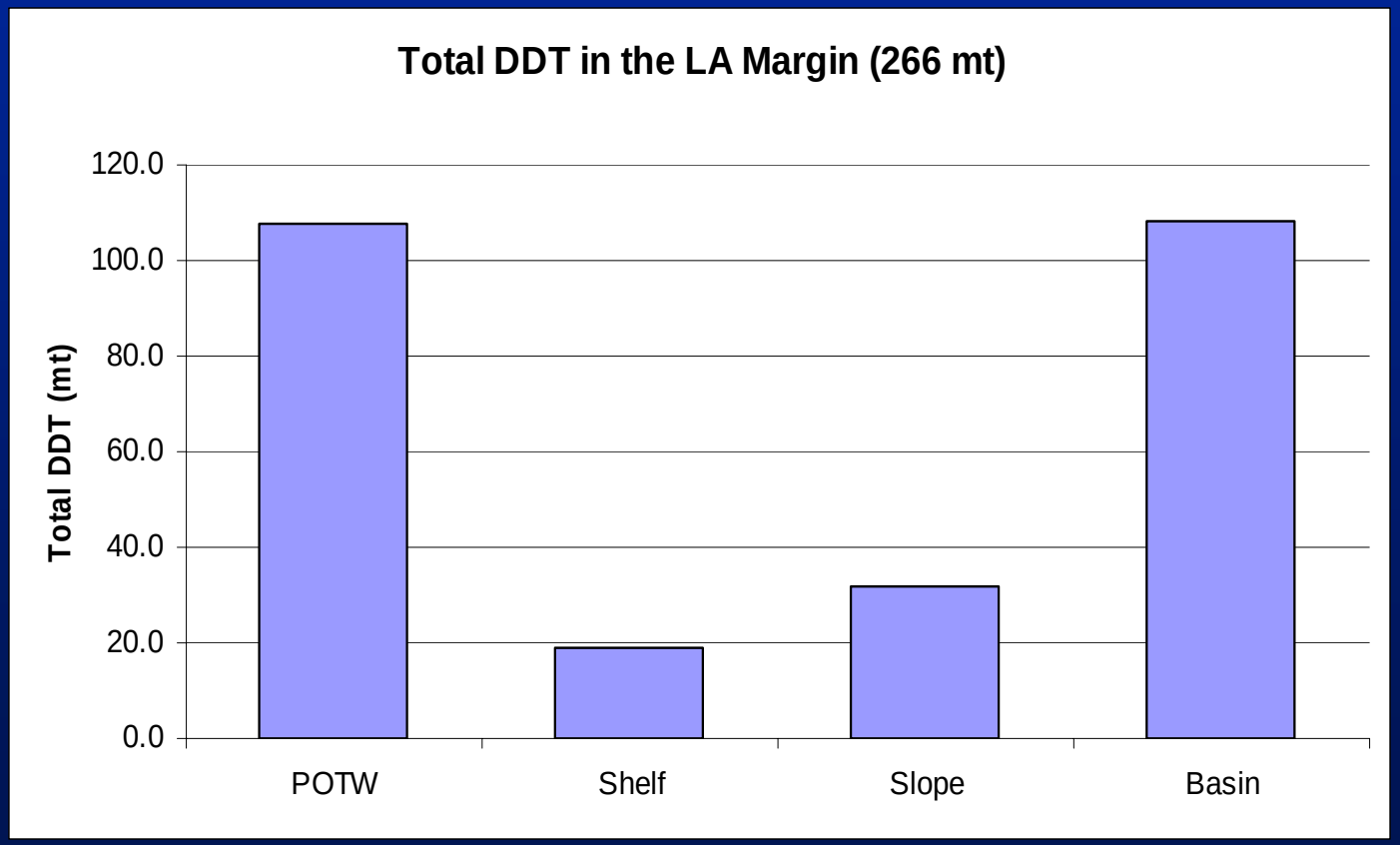


# DDT in Seawater (Zeng et al., 2005)

- Deployed SPME fibers in 2003-2004
  - 63 sites
  - 2 m above bottom to surface
  - Supplemented data from 2003 near outfall (3.8 ng/L)
- DDT mass estimates
  - 0.84-2.4 MT annual flux
  - ~10 MT total flux

# DDT in LA Margin Sediments (Bight'03, USGS)

- Concentrated sampling in LA Margin
  - 40 box cores
  - 30 probabilistic, 10 targeted
  - Three strata (Shelf, Slope, Basin)
- Supplemented USGS cores of PV Shelf and Santa Monica Bay (POTW)
- DDT mass estimates
  - 266 MT in LA Margin
  - Basin = POTW mass



# Current DDT Mass Balance

| Compartment | Mass of tDDT |
|---|---|
| Benthic Fish (Bight'98) | < 1 Kg |
| Pelagic Fish (Bight'03) | 1 - 25 Kg |
| Water Column (Zeng et al., 2005) | ~10 MT (~1 MT annual flux) |
| Sediment (Bight'03, USGS) | ~266 MT |

# DDT Mass Balance Questions Revisited

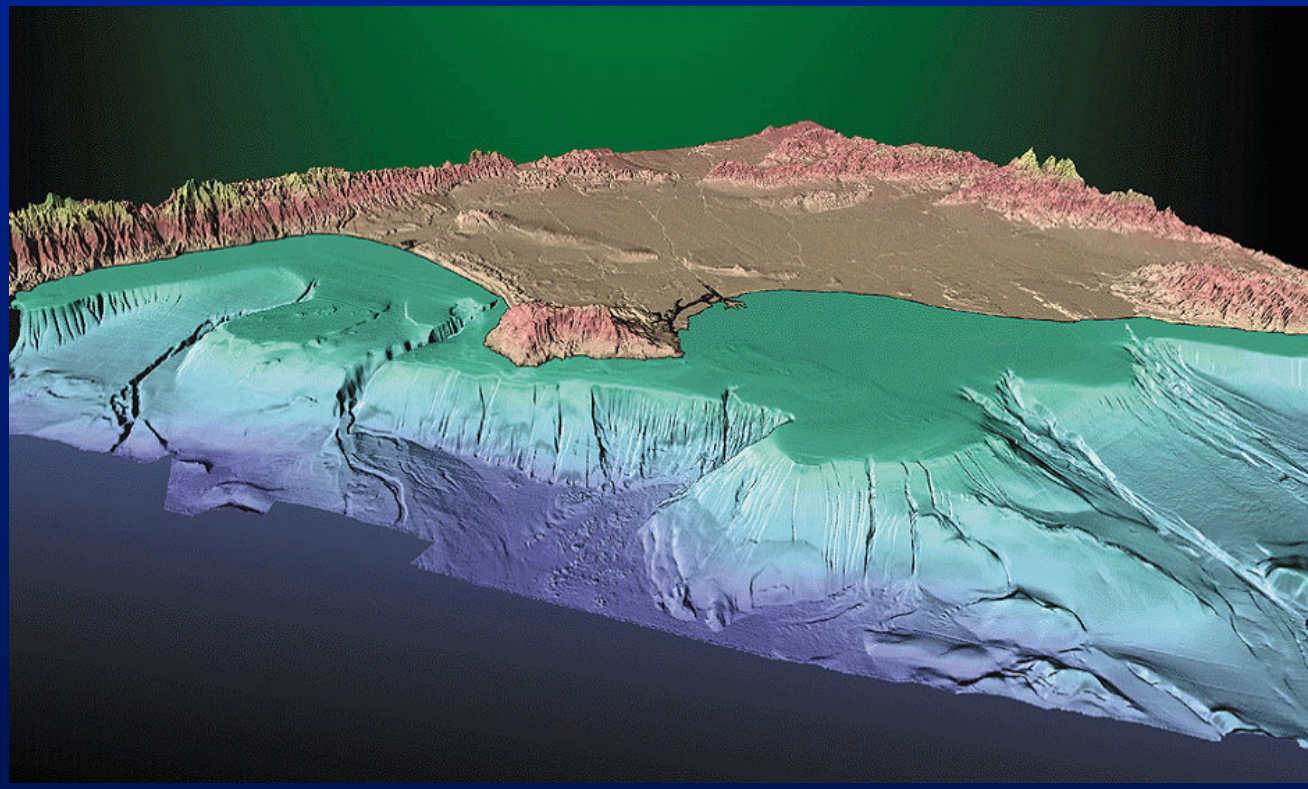
- What is the mass of DDT in the Southern California Bight (SCB)?
  - 276 metric tons of DDT is accounted for in the SCB
  - Greatest mass in sediments near POTW outfalls and associated basin
- How does the DDT mass compare among various environmental compartments?
  - tDDT mass in sediment > water column flux >> fish
- How does the mass compare to what we estimate was discharged?
  - Only ~11% of estimated tDDT discharged (2400 MT) can be found

# Where is the Missing 90%?

- It was never discharged
  - -790-1315 MT (Eganhouse and Pontolillo, in press)
- It is in the deep basins near the LA Margin
  - -Very limited assessment in Bight'03
- It is in the sediment outside LA Margin
  - -Unknown at this time but could be estimated
- It has degraded into unmeasured compounds
  - -DDMU is ~10% of routinely measured "total DDT" on PVS
- It is in other unmeasured biological compartments
  - -Little to no data on birds, mammals, and humans
- It has been carried out of the SCB
  - -~60 years of constant efflux from SCB by currents and biota

# Next Steps: Bight'08

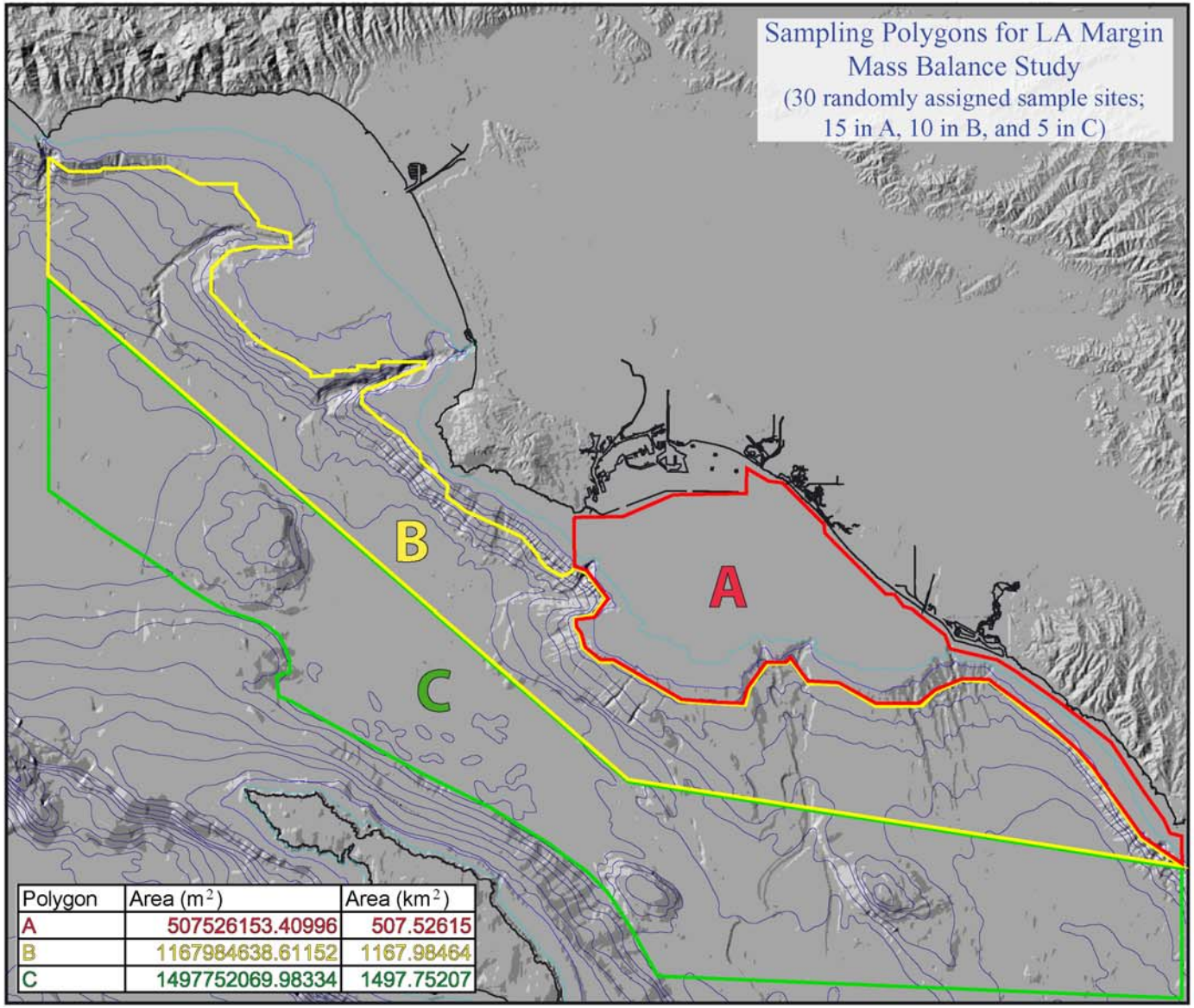
- Continue to put the pieces together
  - Reassess total mass discharged
  - Estimate for sediments beyond LA margin
  - Better estimate for deep basins around LA margin (Bight'08)
  - Measure DDMU etc. in sampled compartments (Bight'08)
- Use Special Studies in MMP to supplement regional monitoring efforts



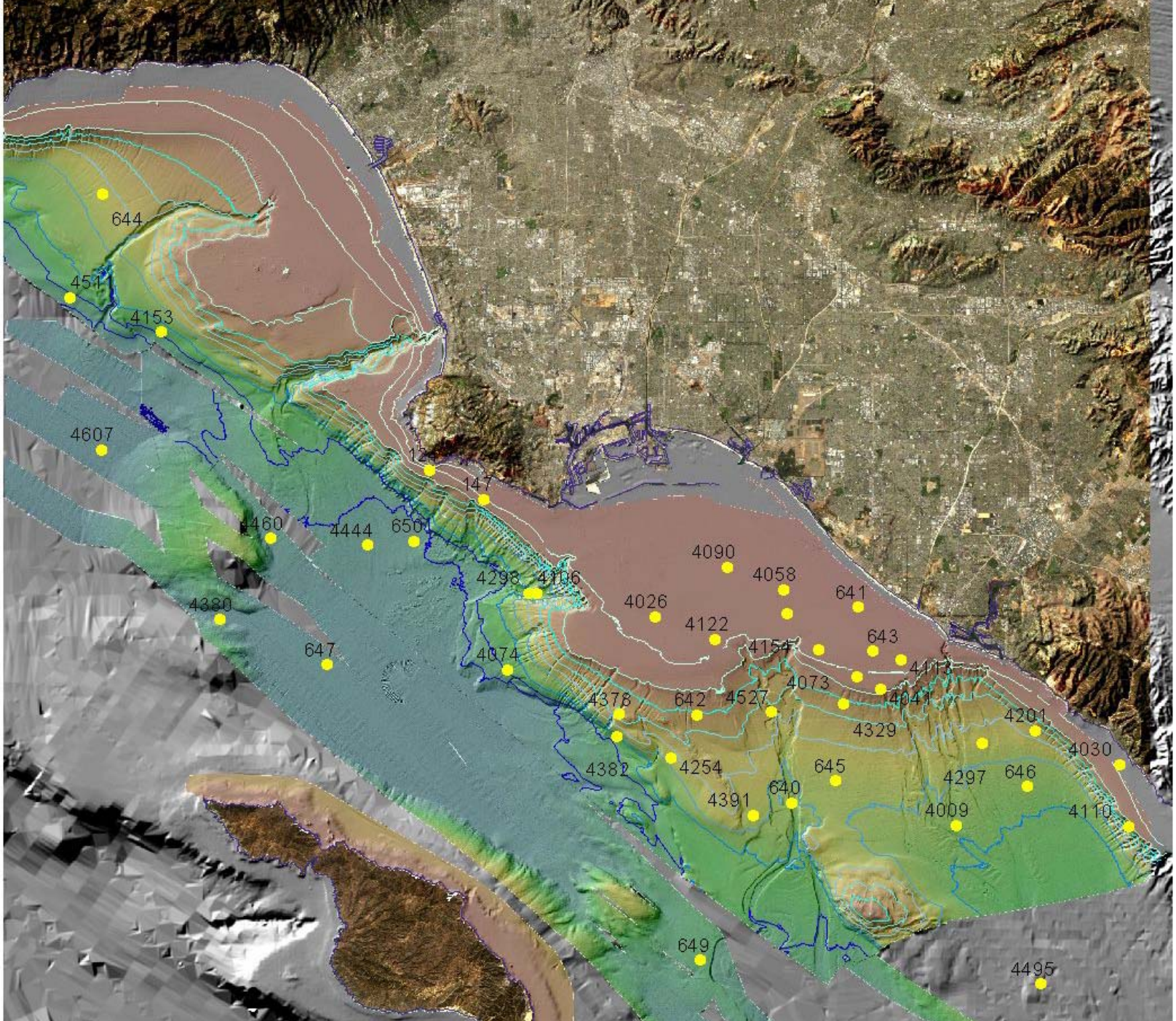
# Questions?

# “Bight” and Other Studies Used for DDT Mass Balance Questions

- 40 box cores in the LA margin
  - 30 probabilistic, 10 targeted
- Three strata
  - San Pedro shelf, LA Margin slope and basin
- Combine with other SCB studies for mass balance
  - USGS cores of PV Shelf and Santa Monica Bay
  - SPME Water column surveys
  - B’03 pelagic fish survey
  - B’98 benthic fish survey




| Polygon | Area ($m^2$) | Area ($km^2$) |
|---|---|---|
| A | 507526153.40996 | 507.52615 |
| B | 1167984638.61152 | 1167.98464 |
| C | 1497752069.98334 | 1497.75207 |


644
4511
4153
4607
147
4460
4444
6501
4298
4106
4090
4058
641
4026
4122
643
4380
647
4074
4154
4073
4378
642
4527
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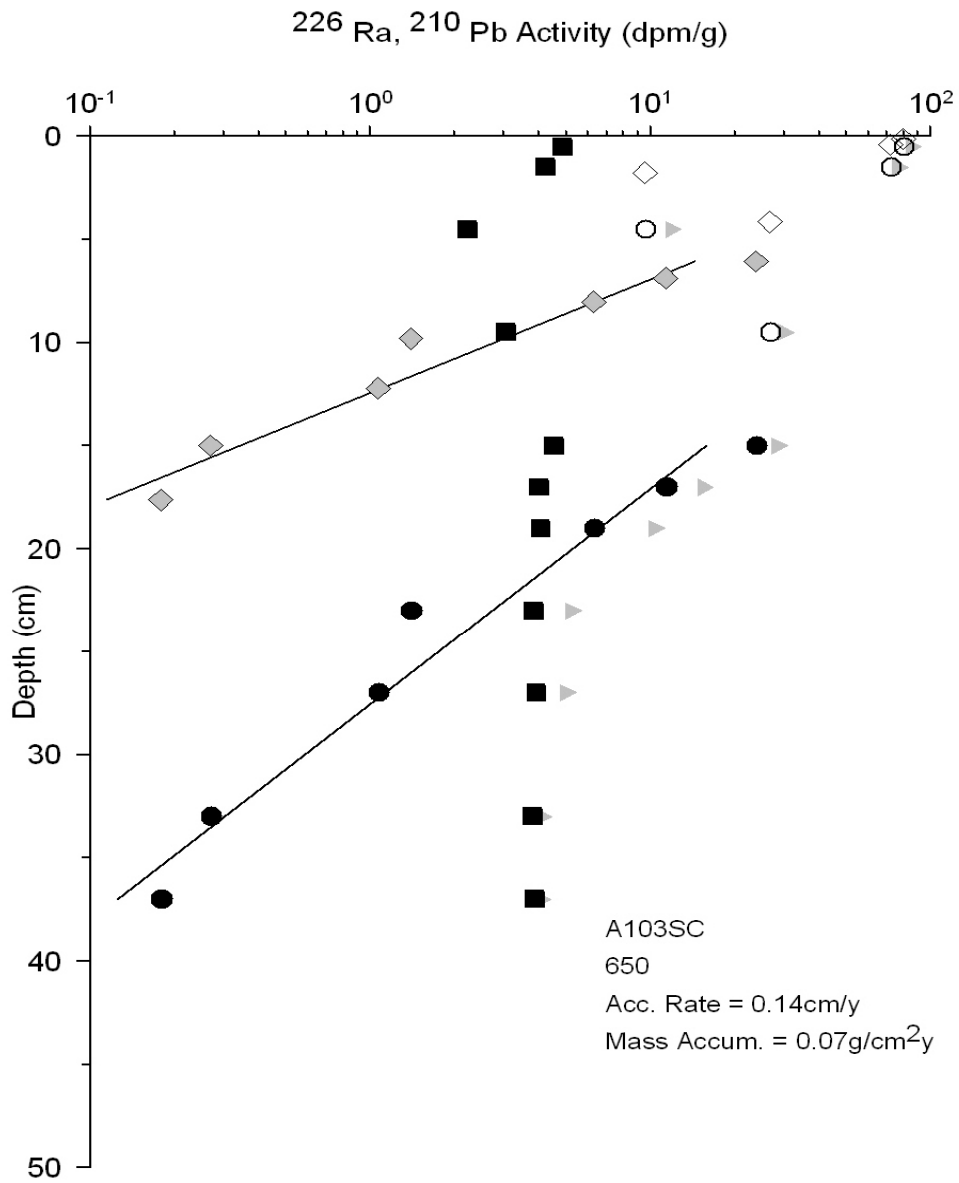
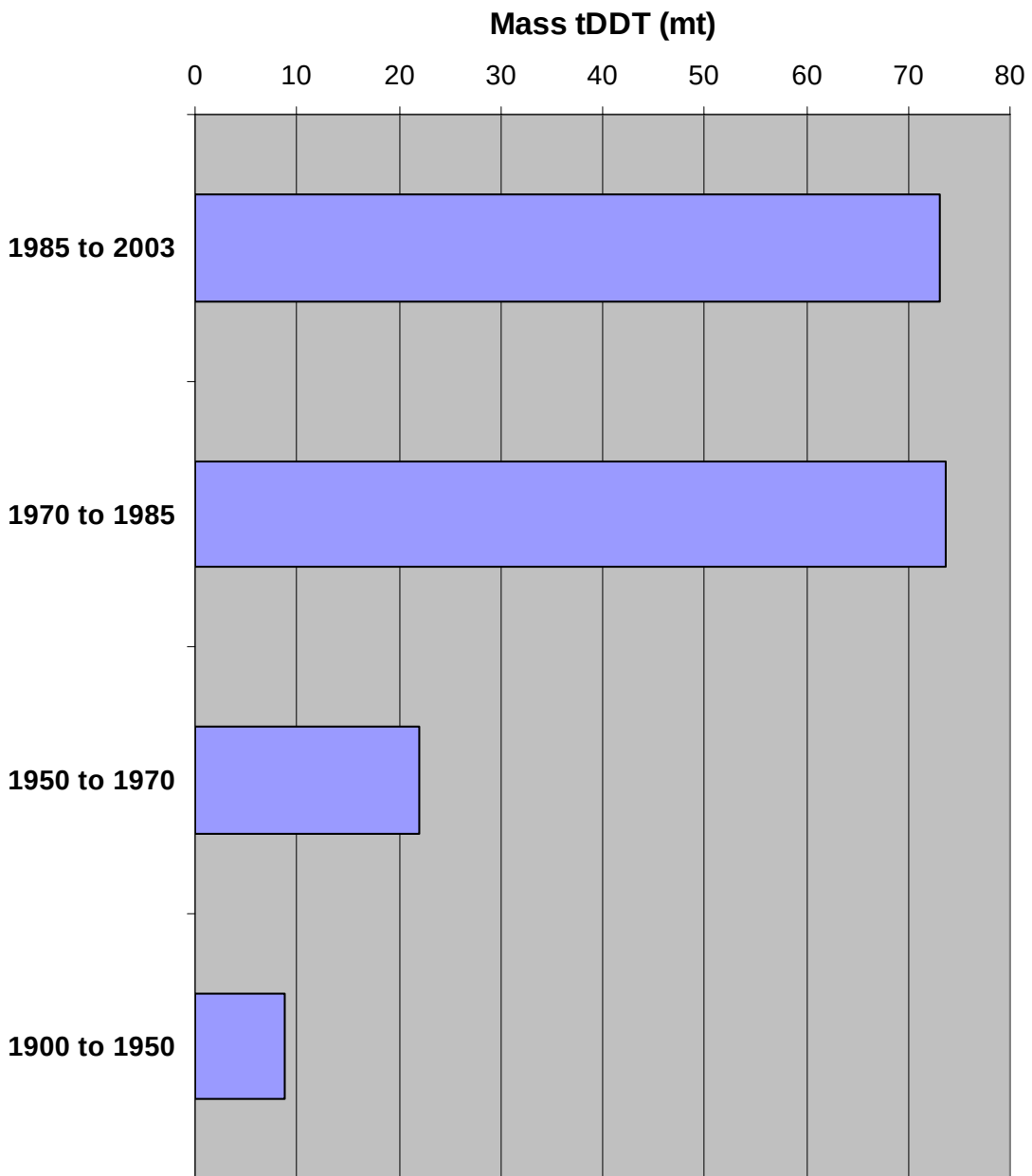
4201
4030
4382
4254
645
4297
646
4391
640
4009
4110
649
4495


226 Ra, 210 Pb Activity (dpm/g)
10-1
100
101
102
0
10
20
30
40
50
Depth (cm)
A103SC
650
Acc. Rate = 0.14cm/y
Mass Accum. = 0.07g/cm2y

# Bight'03 Cores



# Mass Balance Design
# Water Column

- Used solid phase microextraction (SPME)
- 60 sites bightwide
  - enhancement in LA margin
- 3 week deployments

# Sample Analysis

- Radiochemistry for dating
  - $Pb^{210}$, $Ra^{226}$, $Cs^{137}$, $Th^{234}$
- Divided into four time periods for sediment chemistry
  - 2003 to 1985
  - 1985 to 1970
  - 1970 to 1950
  - 1950 to 1900
- Core geomorphology