The Lower Mississippi River Flood of 2008

Sediment Dynamics and Implications for Coastal Restoration

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with
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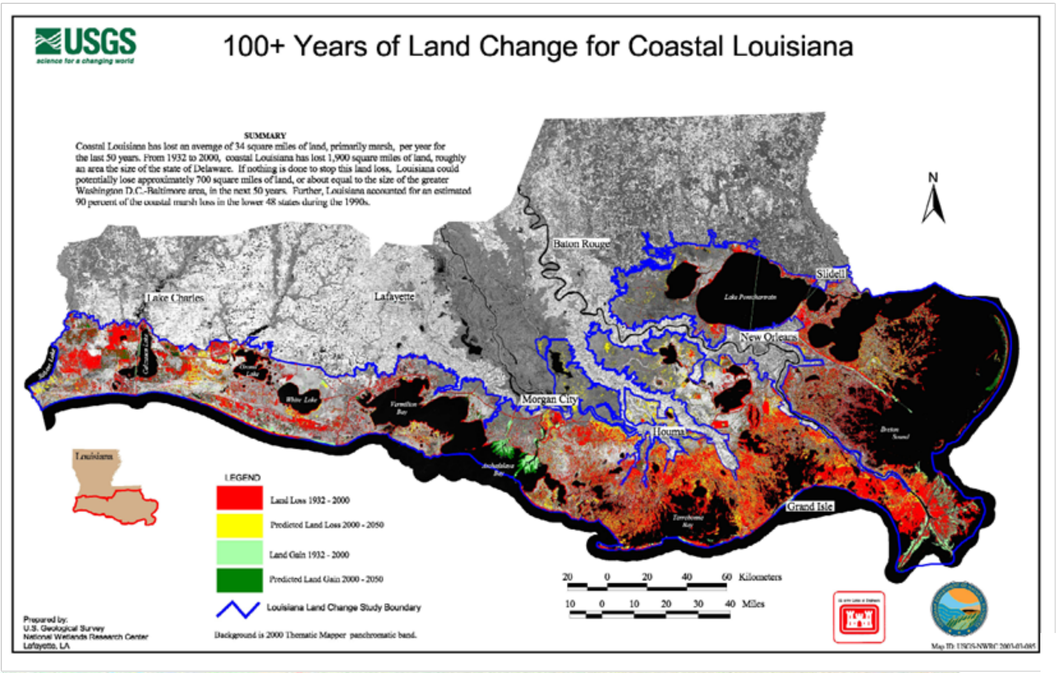
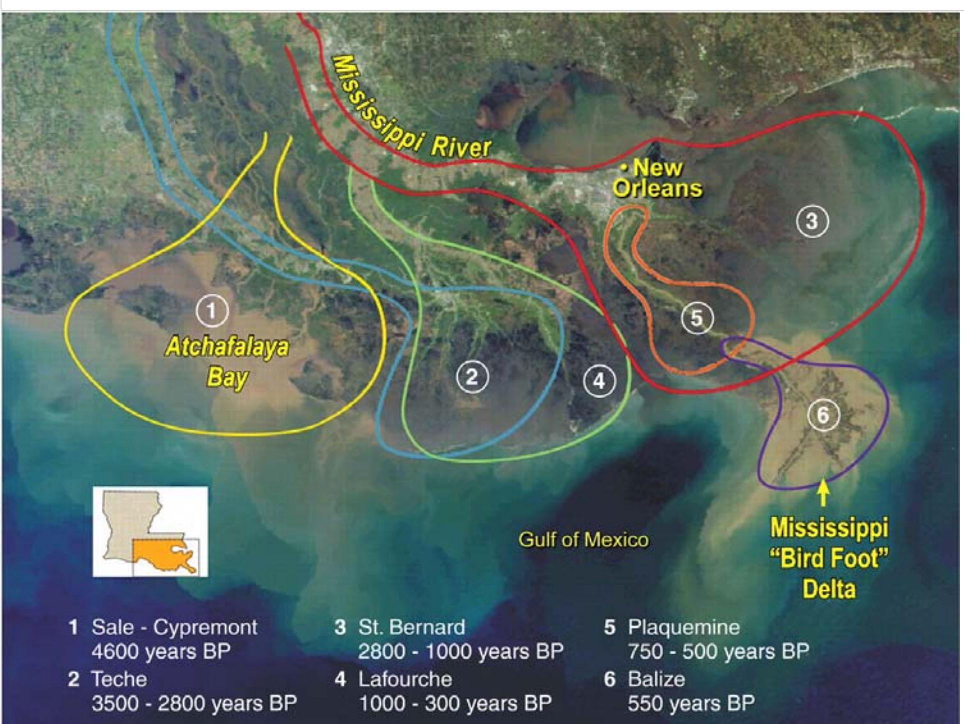
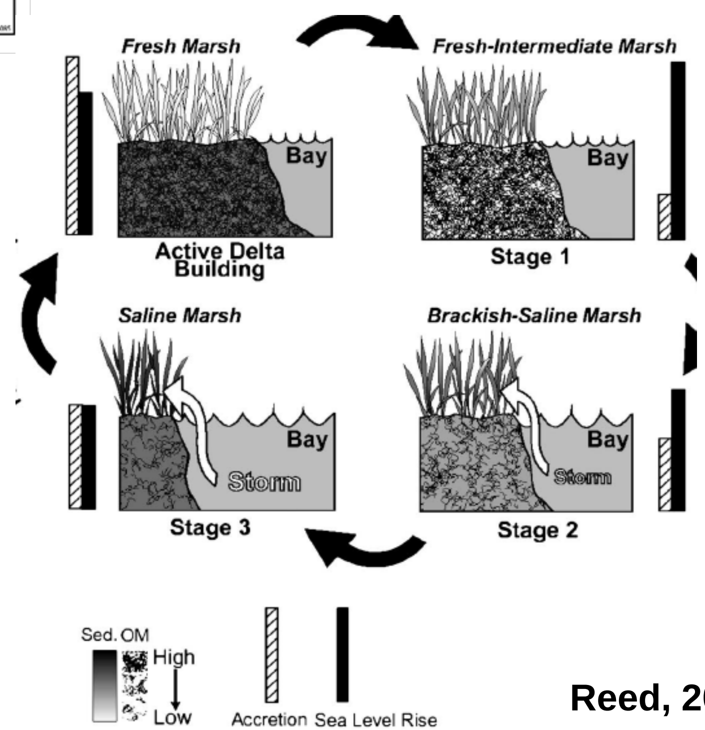
Though there are many causes of land loss in coastal Louisiana, the effects of subsidence rates and reduced sediment loads play an important role. Restoring the coast involves reintroducing the alluvial processes that created this landscape



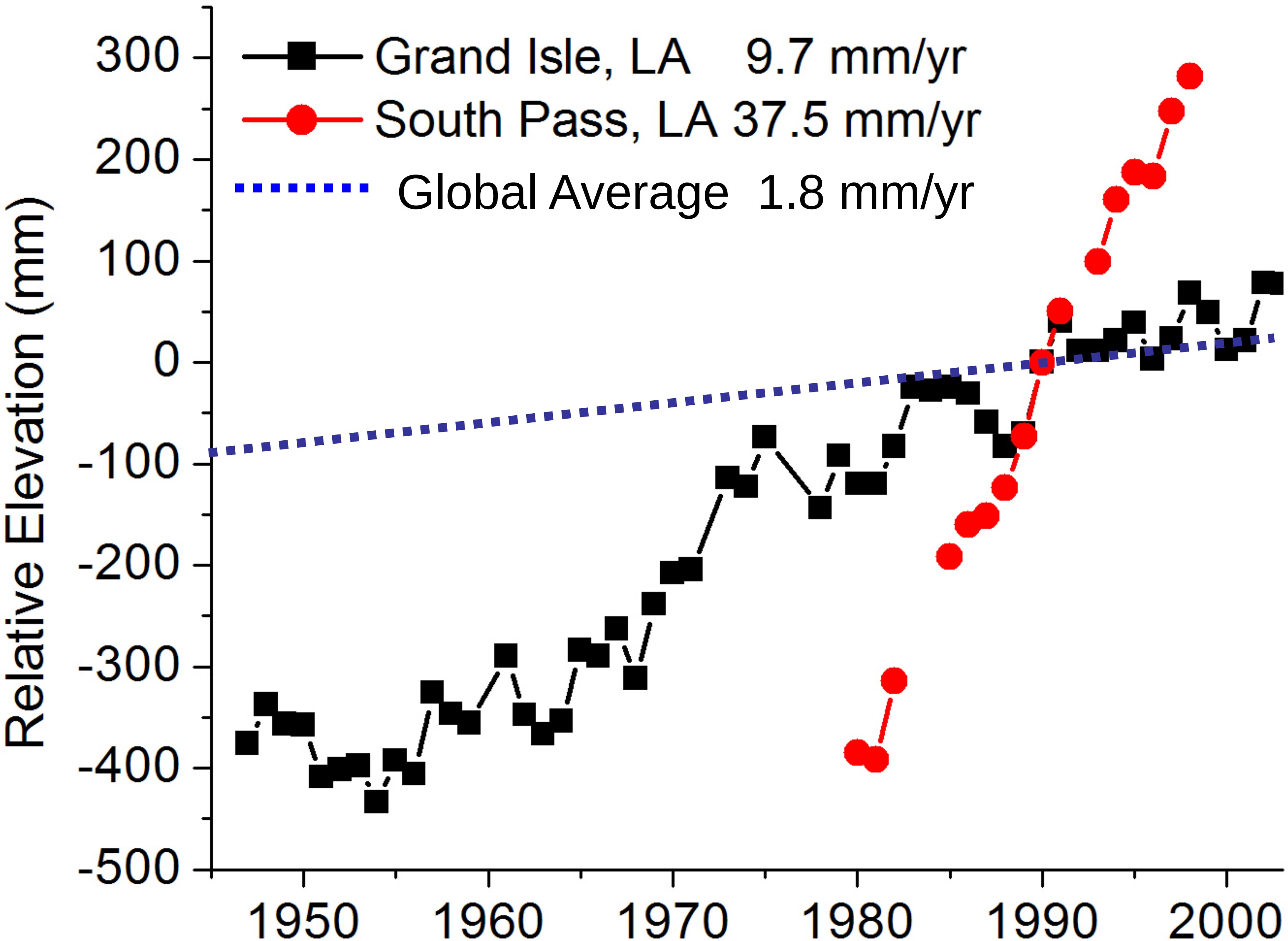


Day et al., (2007)



Reed, 2002

Relative Sea Level Rise in the Lower Mississippi River



Sources: Permanent Service for Mean Sea Level, Annual means based on years with > 4 months data. 1990 = 0.
Global sea level from Miller and Douglas (2004), IPCC (2007)

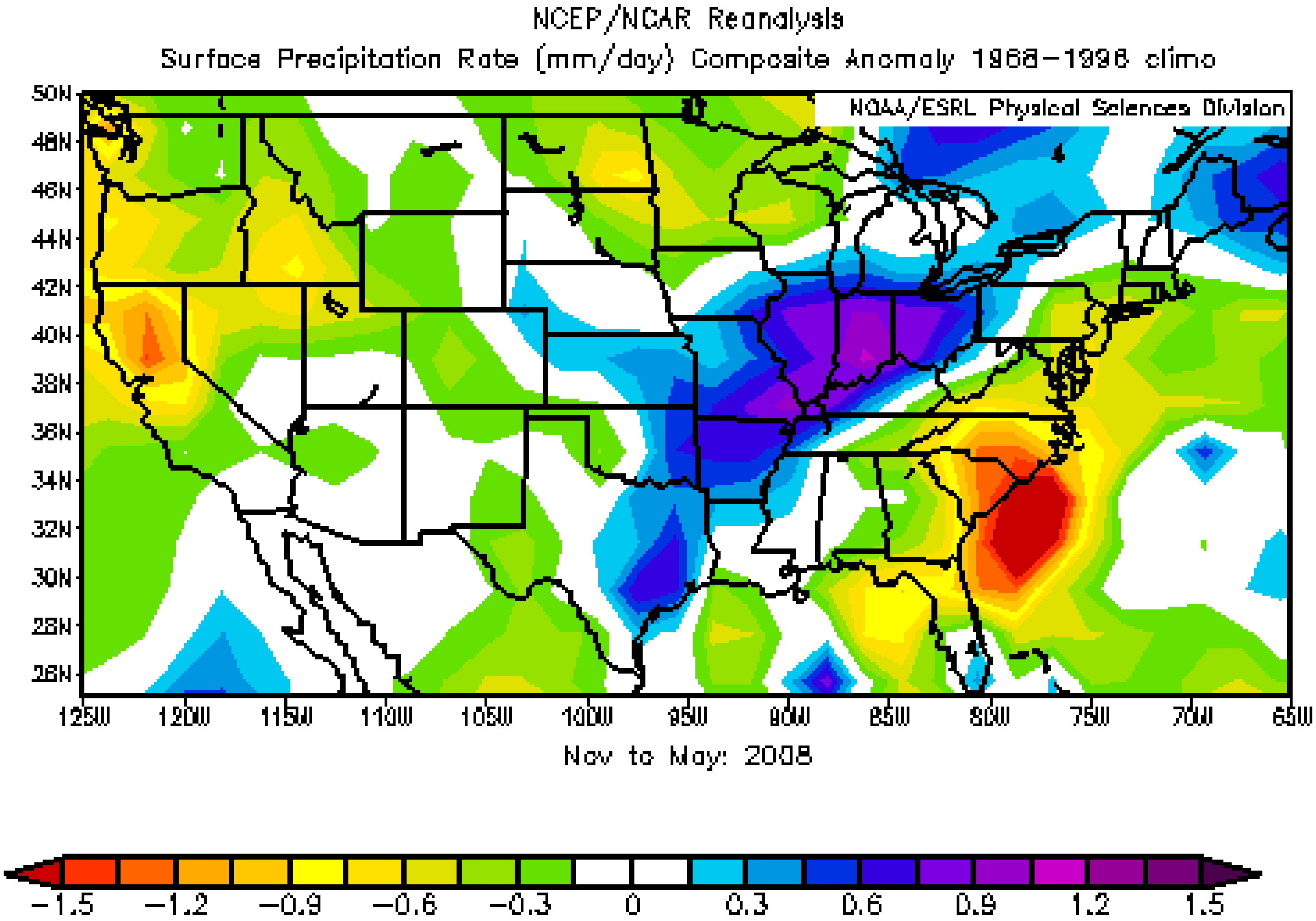
Research Topics

- Sediment Dynamics in Wetlands and Deltas (Kolker)
- Consequences of Global Climate Changes on Coastal Systems (Kolker)
- Dynamics of organic carbon in rivers (Rosenheim)
- Records of land use and climate change preserved in sediments and carbonate (Rosenheim, Kolker)

Research Tools

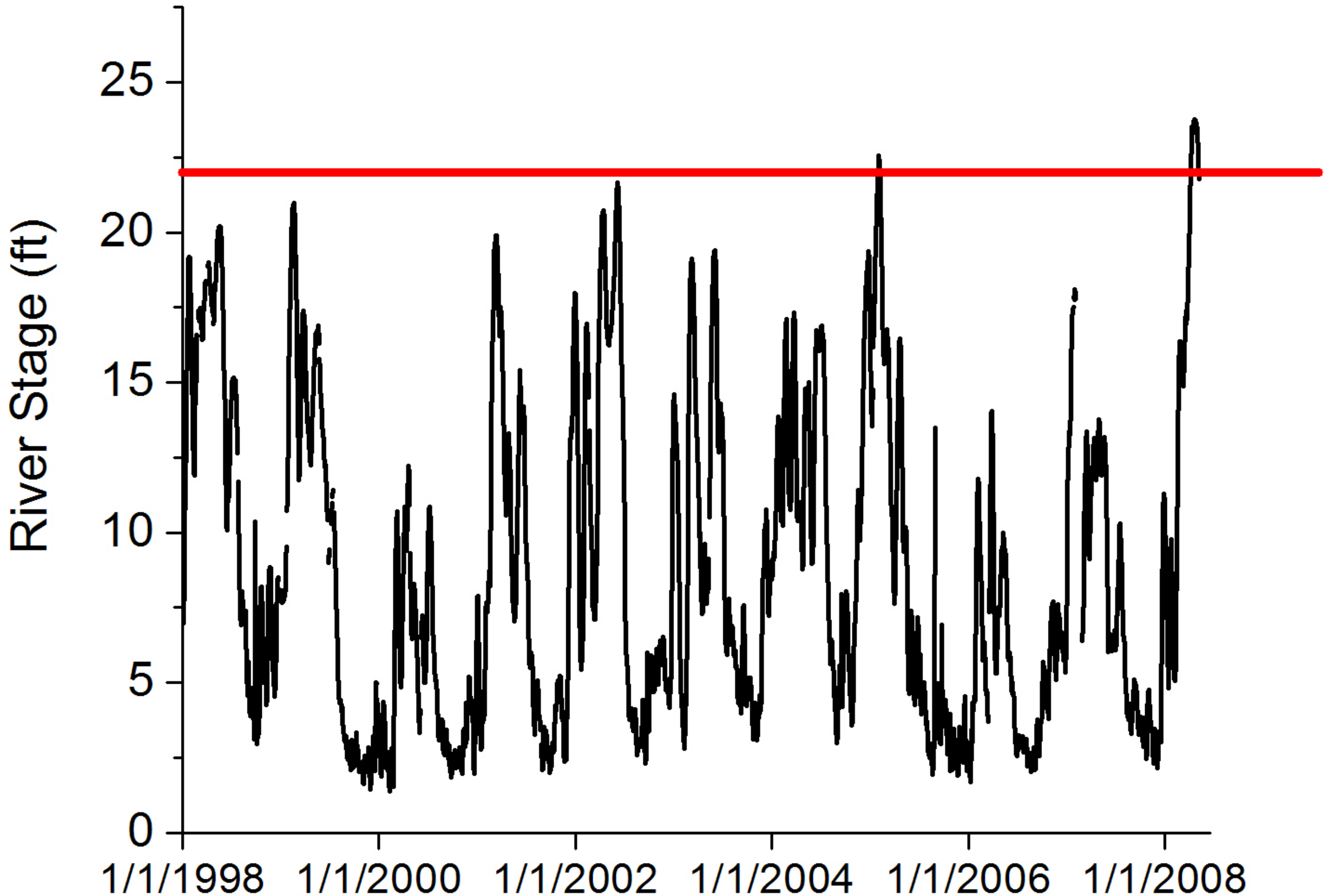
- Radioisotopes ^{210}Pb, ^{234}Th, ^{7}Be, and ^{137}Cs, ^{14}C (Kolker, Rosenheim)
- Light Stable Isotopes: ^{18}O, ^{13}C, ^{15}N, ^{2}H (Rosenheim)
- Sedimentological tools: grain size via laser diffraction, digital x-radiography (Kolker)
- Pyrolysis of acid insoluble organic carbon (Rosenheim)

Precipitation Rate Anomaly Nov. 2007- May 2008



mm/day

In the spring of 2008, the lower Mississippi River (measured here at Reserve) experienced it's highest level in over a decade



source: www.mvn.usace.army.mil

Research Questions

- How much sediment is deposited during a high water event? How does sediment distribution during a flood differ between wetland and open-water environments. Is this enough sediment to keep pace with recent rates of relative sea level rise?
- Can differences in thermochemical stability of the various components of river-derived bulk organic carbon (AIOM) be exploited through pyrolysis/combustion of demineralized sediments to separate these components into fractions of different ages?

Mississippi River From Space (MODIS) May 20, 2008

http://rapidfire.sci.gsfc.nasa.gov/

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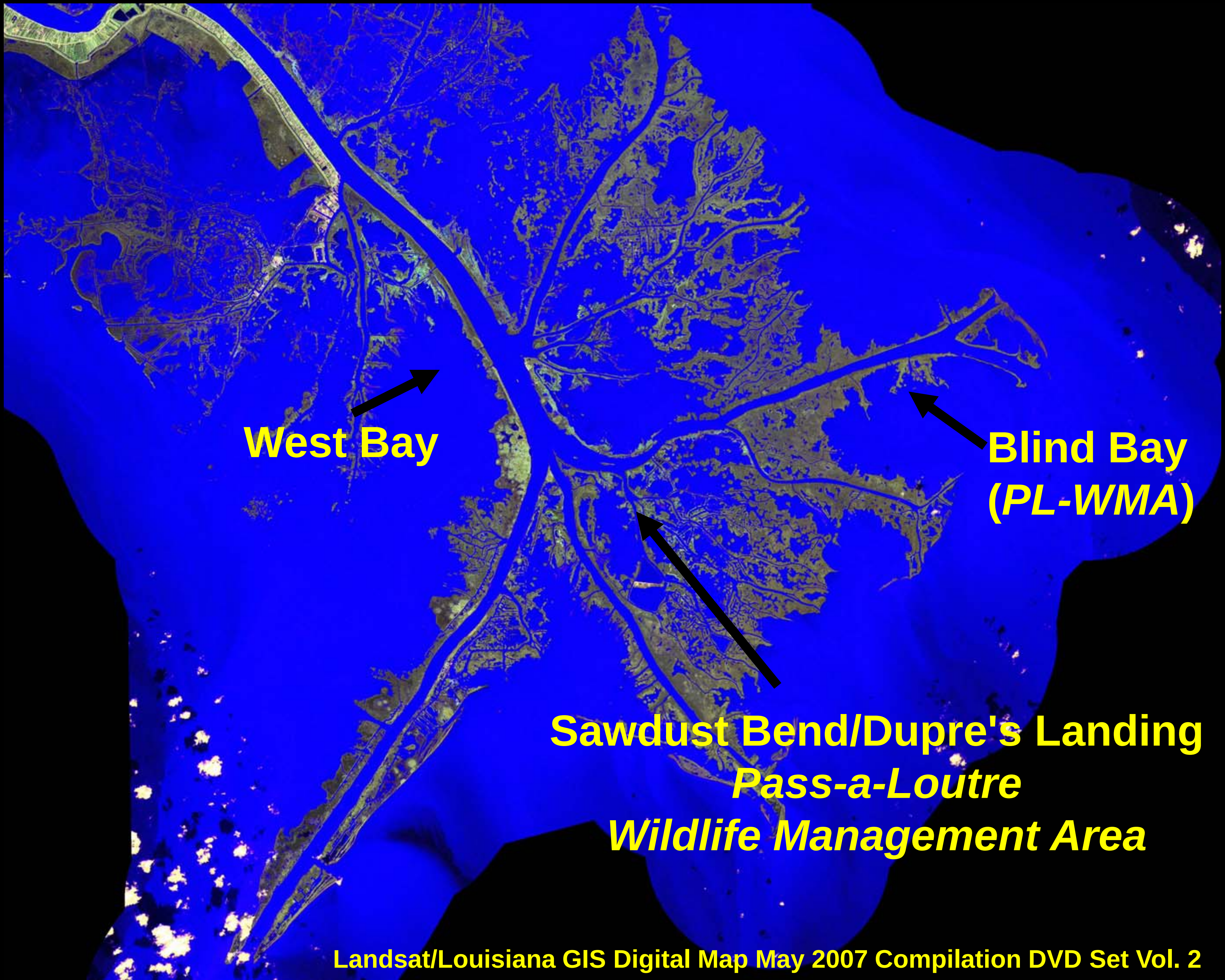
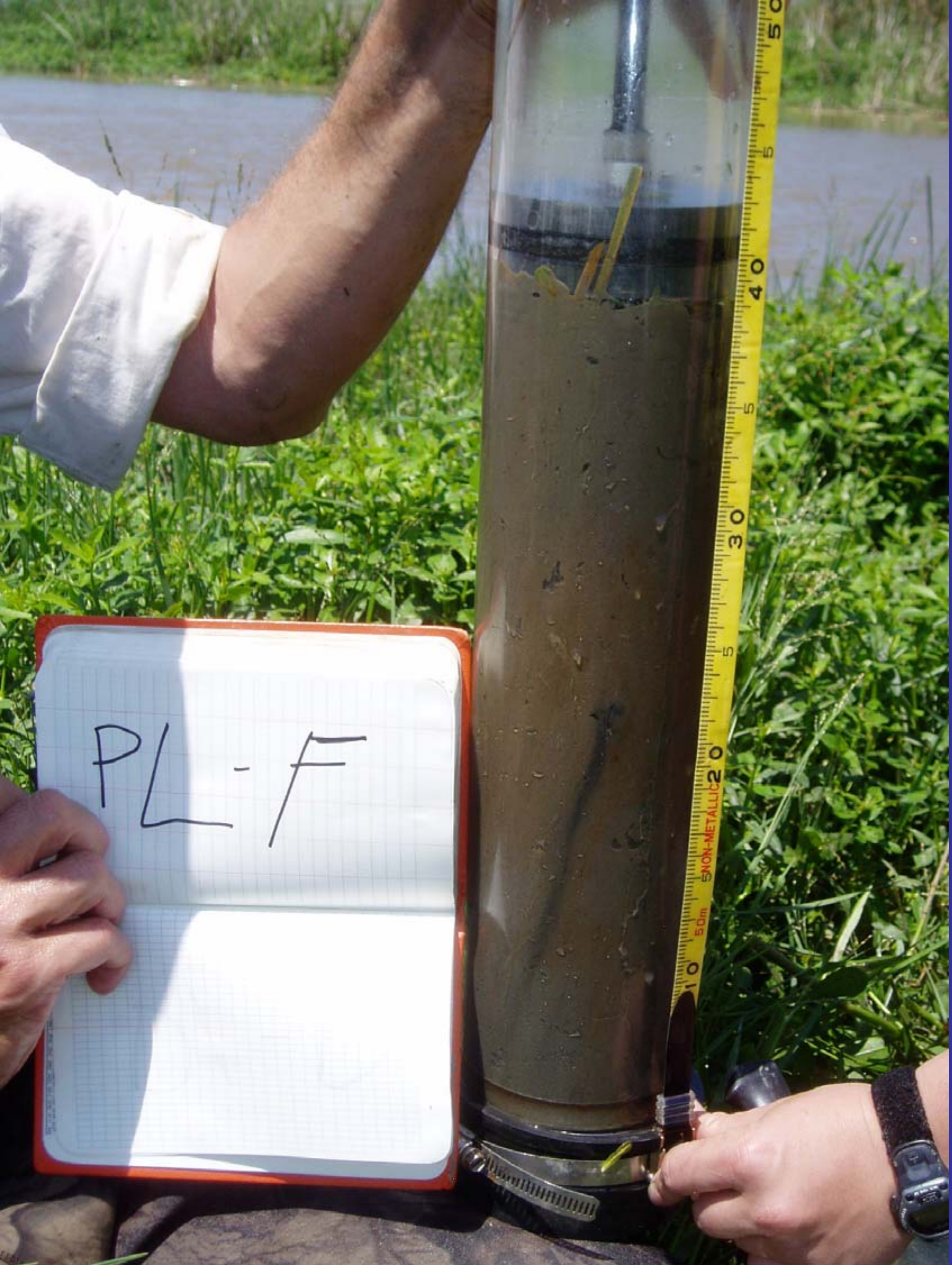

West Bay
Blind Bay
(PL-WMA)
Sawdust Bend/Dupre's Landing
Pass-a-Loutre
Wildlife Management Area
Landsat/Louisiana GIS Digital Map May 2007 Compilation DVD Set Vol. 2

Saw Dust Bend
Artificial Crevasse open c.1988

Image: Google Earth

Sampling Transect at Dupre's Landing

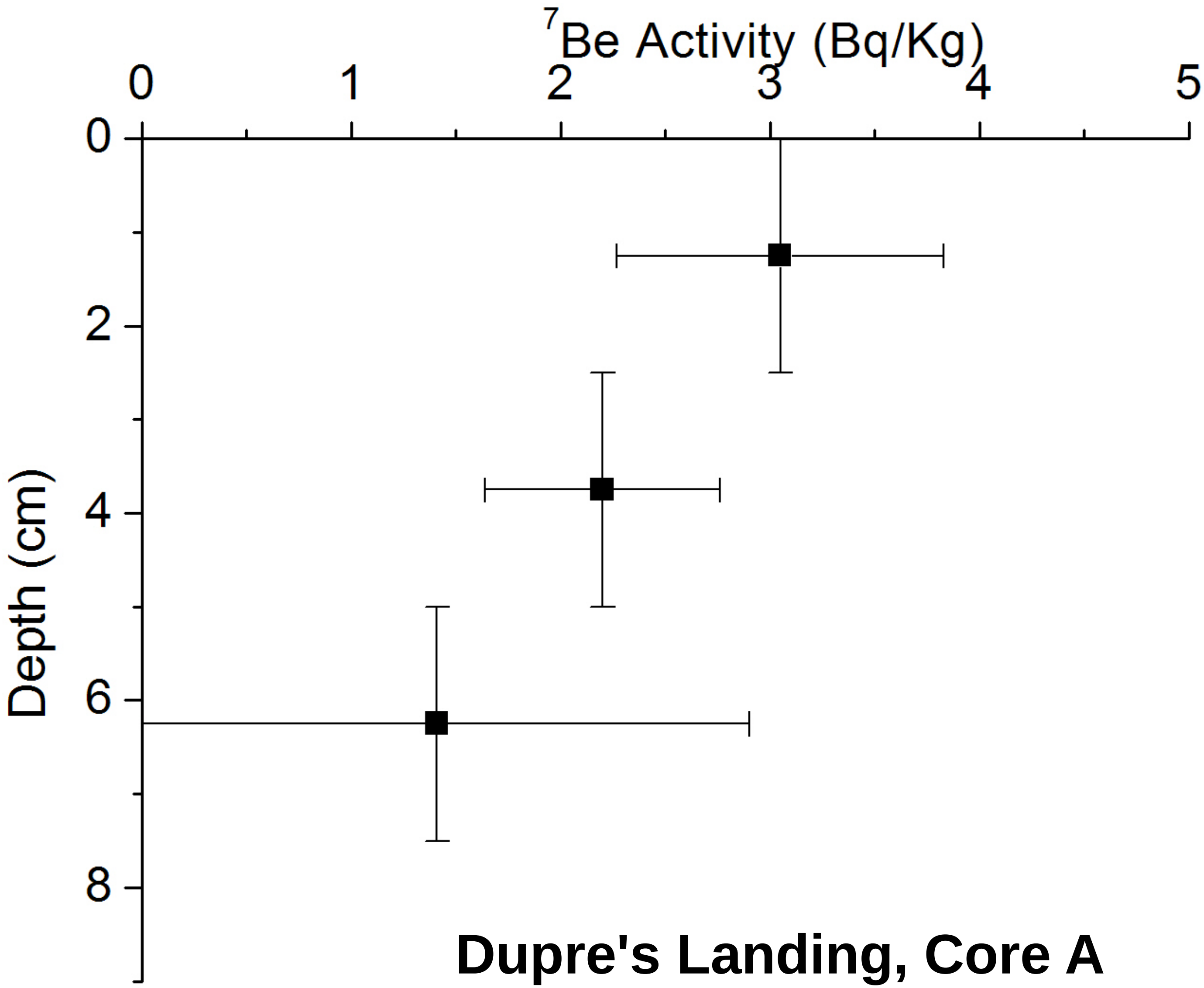
Image: Google Earth



Core collected on Dupre's Landing

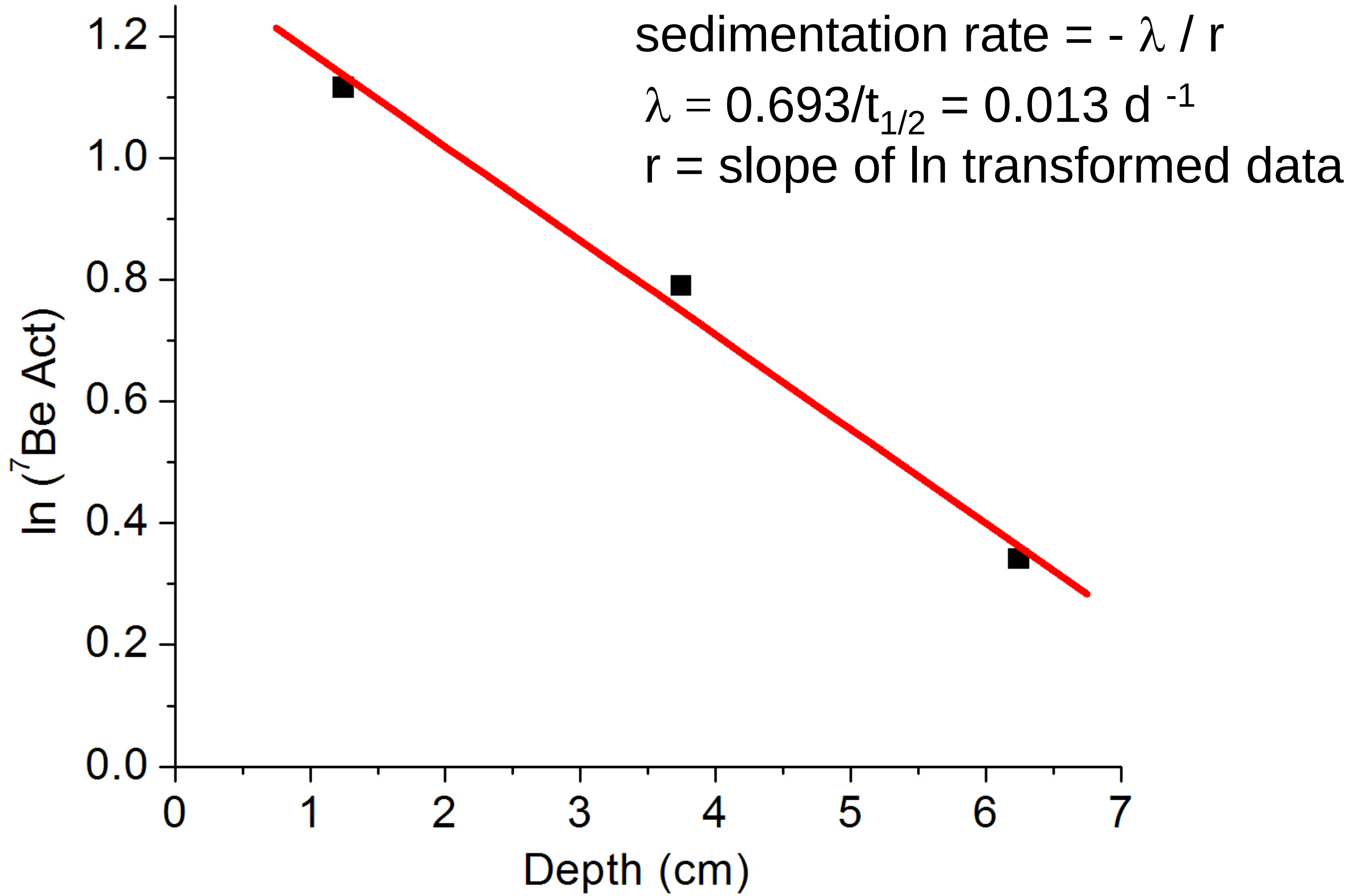
^{7}Be Analysis

- ^{7}Be is produced in the upper atmosphere when the sun's rays interact with N and C atoms.
- ^{7}Be is delivered to Earth's surface via wet and dry deposition.
- Chemically, ^{7}Be is particle reactive, which makes it an ideal tracer of recent sediment dynamics.
- Physically, ^{7}Be has a short half life (53.3 days), which makes it an ideal tracer of recent geological activity.

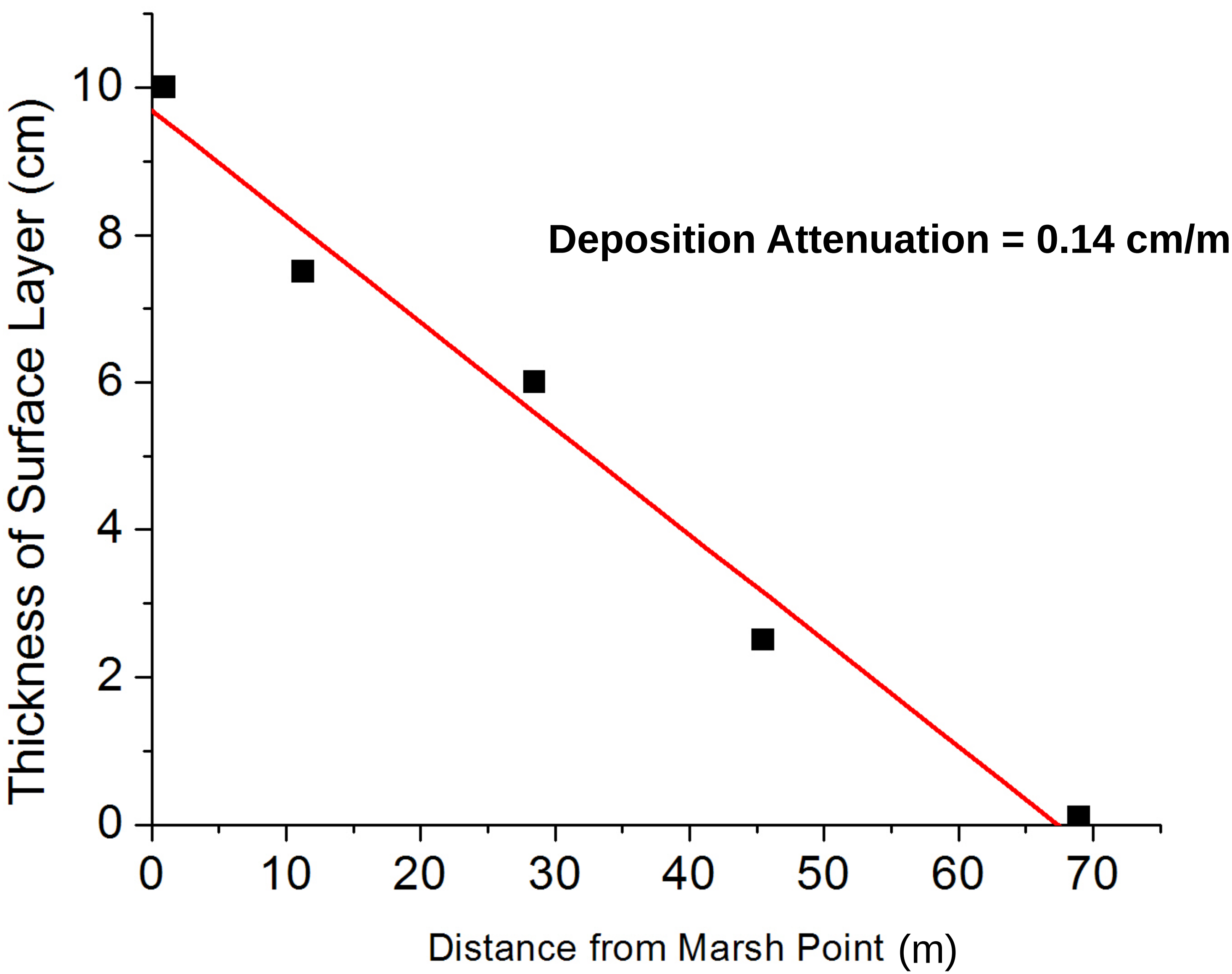


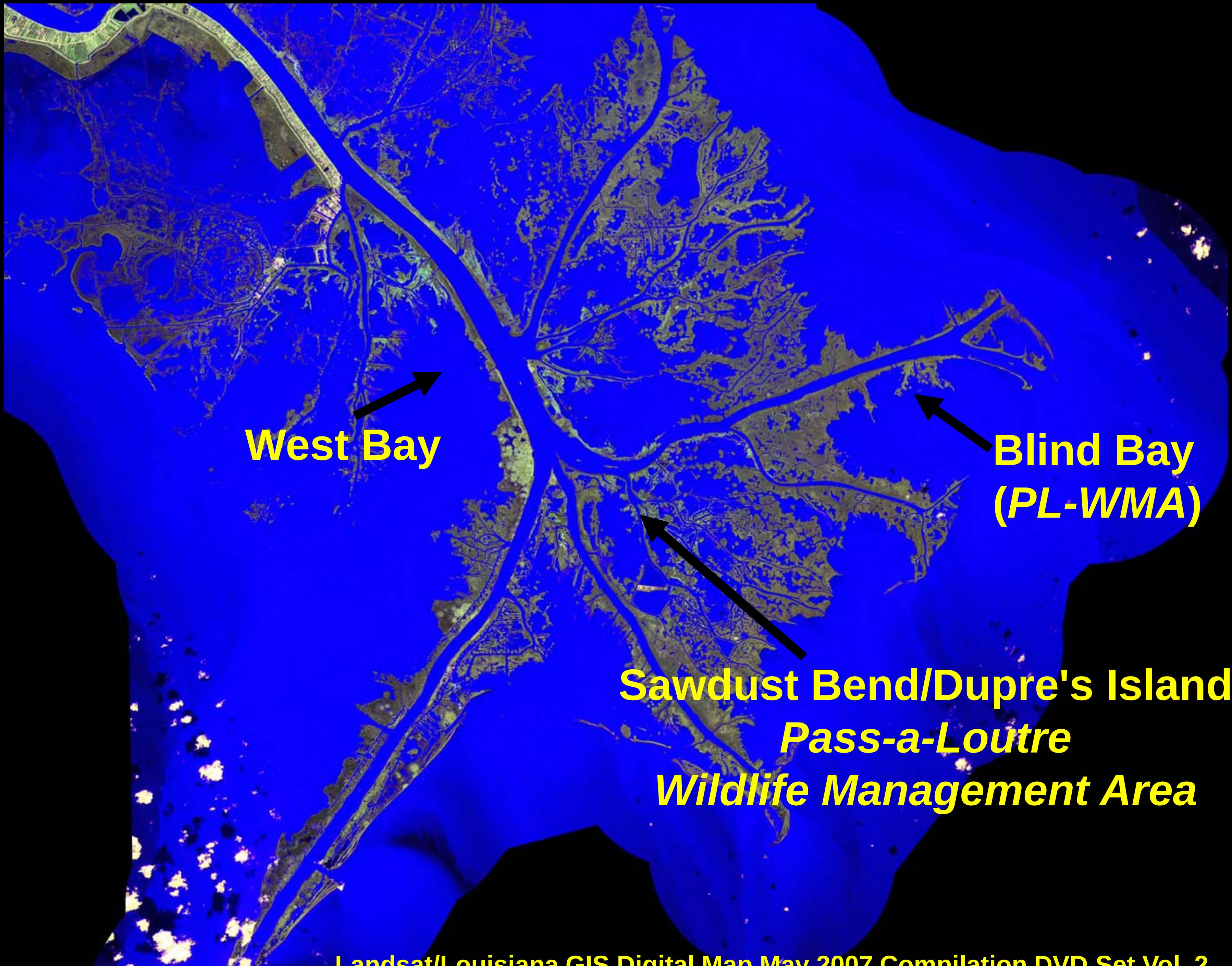
^{7}Be Activity (Bq/Kg)
0
1
2
3
4
5
Depth (cm)
0
2
4
6
8
Dupre's Landing, Core A

Sediment deposition at this marsh location during this event averaged 0.084 cm/day ~ 0.6 cm/week



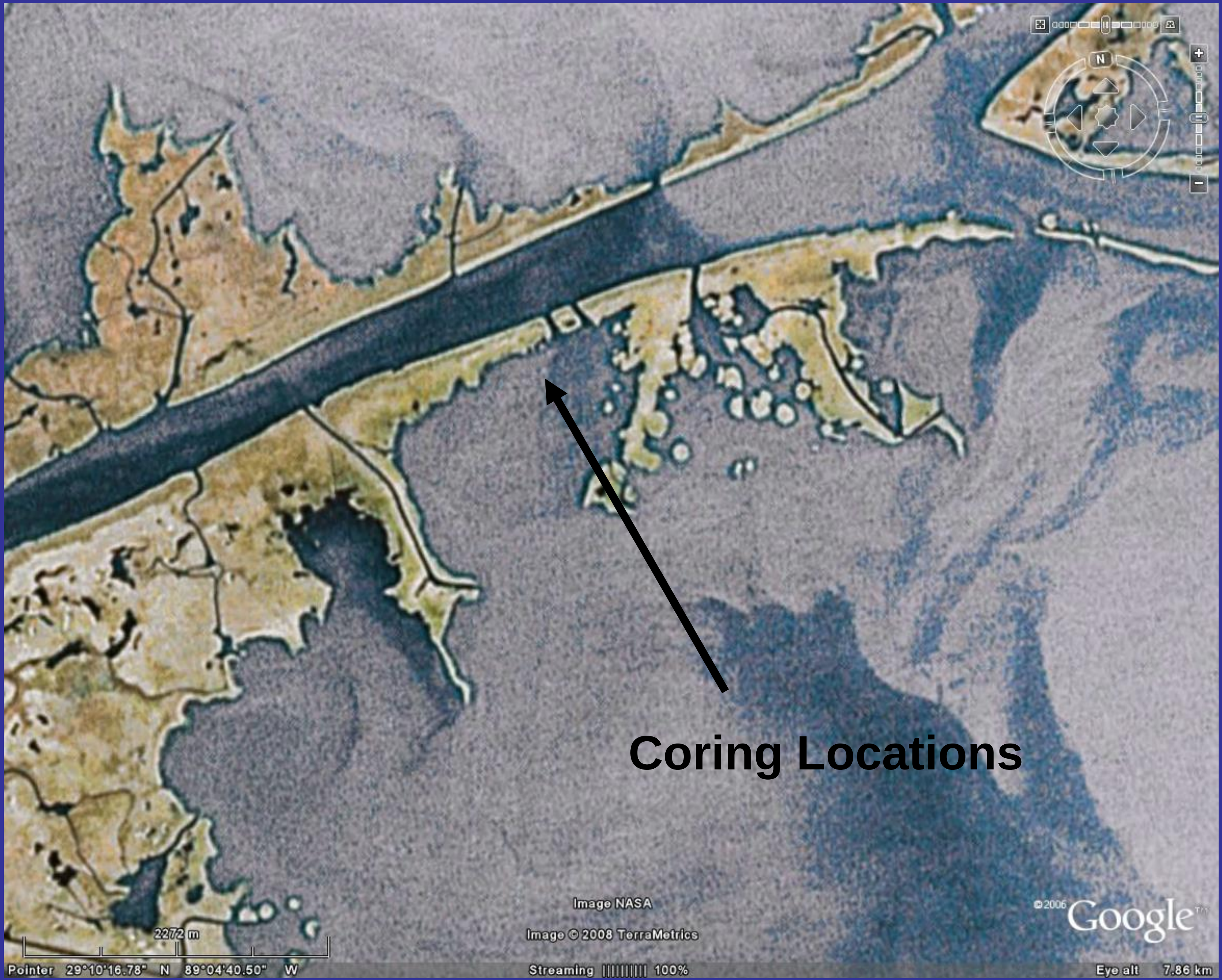
This layer decreased with distance from marsh front





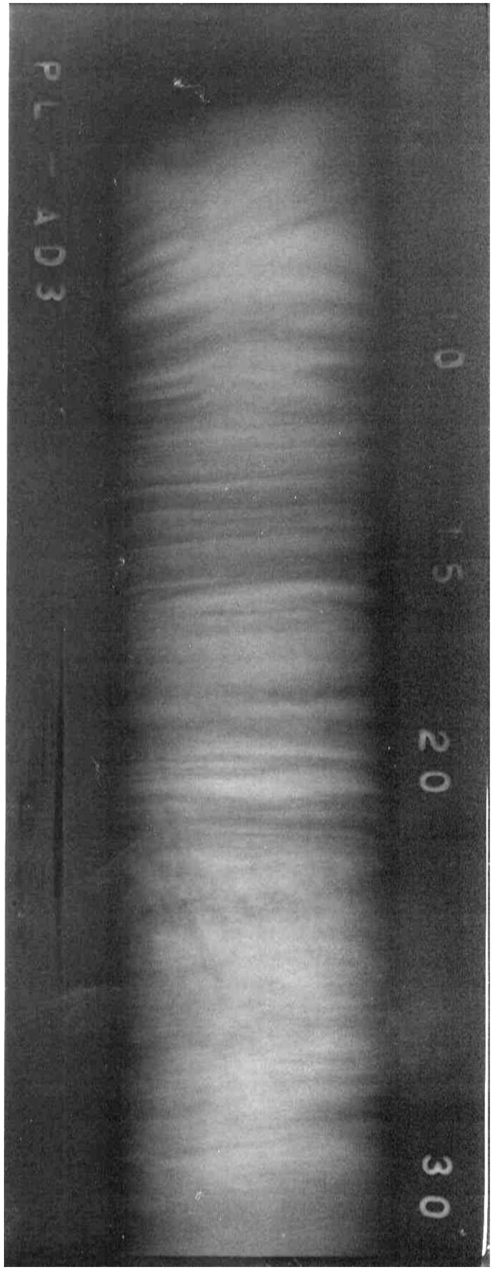
Landsat/Louisiana GIS Digital Map May 2007 Compilation DVD Set Vol. 2

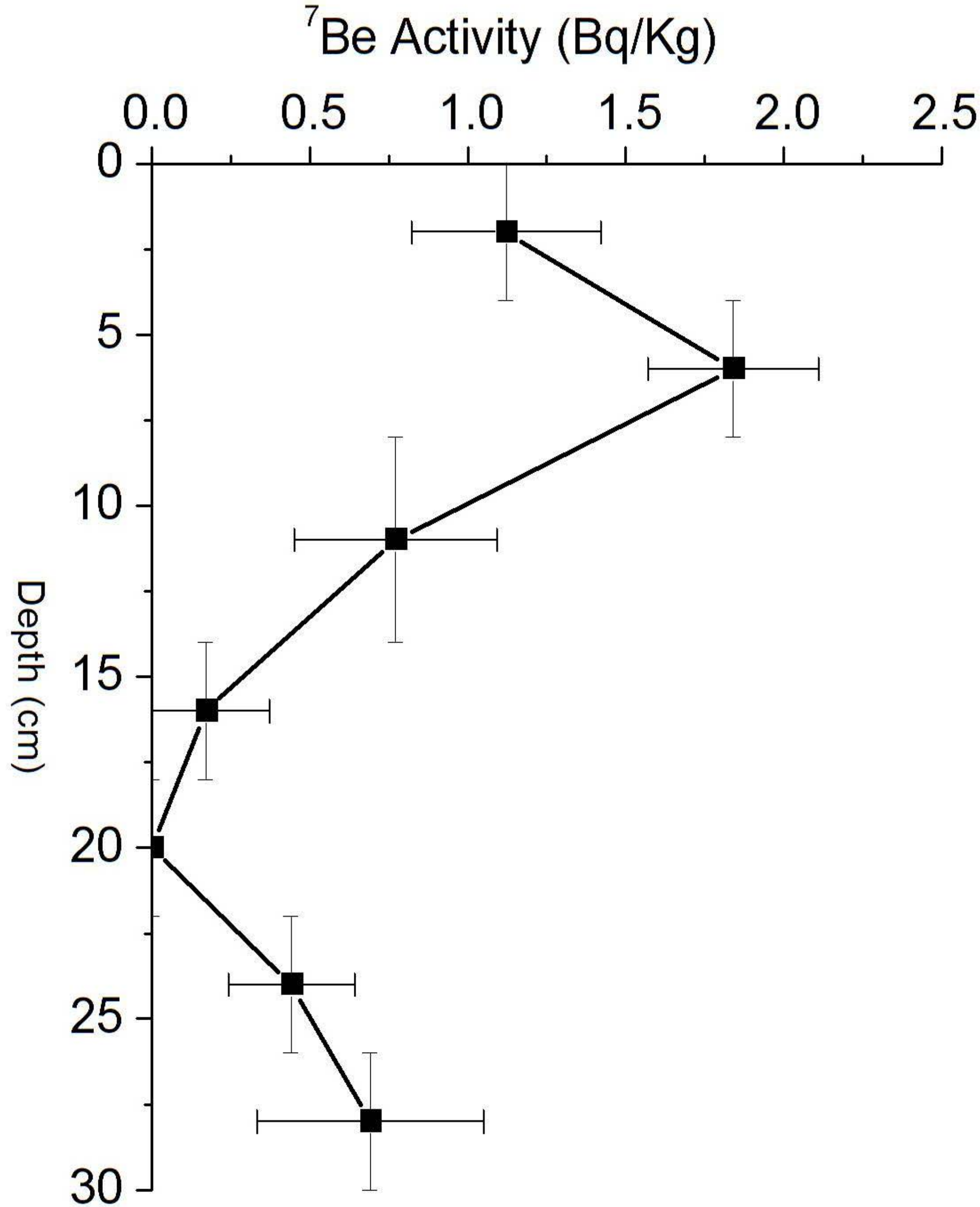
Blind Bay



Coring Locations
Image NASA
Image © 2008 TerraMetrics
© 2006 Google
2272 m
Pointer 29°10'16.78" N 89°04'40.50" W
Streaming |||||||||| 100%
Eye alt 7.86 km

Cores Collected in Shallow Embayment





^{7}Be Activity (Bq/Kg)
0.0
0.5
1.0
1.5
2.0
2.5
Depth (cm)
0
5
10
15
20
25
30

West Bay Diversion

- Construction Completed November 2003
- Designed to carry
  ~ 20,000 cfs fresh water
- Designed to create
  ~ 10,000 acres of land over 20 year life span


Jaquines Island
Brant Island
Savage Island
West Bay 10
West Bay 34
West Bay 11
West Bay 33
West Bay 12
West Bay 35
West Bay 32
West Bay 36
West Bay 13
West Bay 31
West Bay 30
West Bay 14
West Bay 37
West Bay 29
West Bay 15
West Bay 38
West Bay 40
West Bay 28
West Bay 39
West Bay 27
West Bay 17
West Bay 26
West Bay 25
West Bay 19
West Bay 18
West Bay 24
West Bay 23
West Bay 20
West Bay 21
West Bay 23
West Bay 22
6.18 km
© 2009 Europa Technologies
© 2009 Tele Atlas
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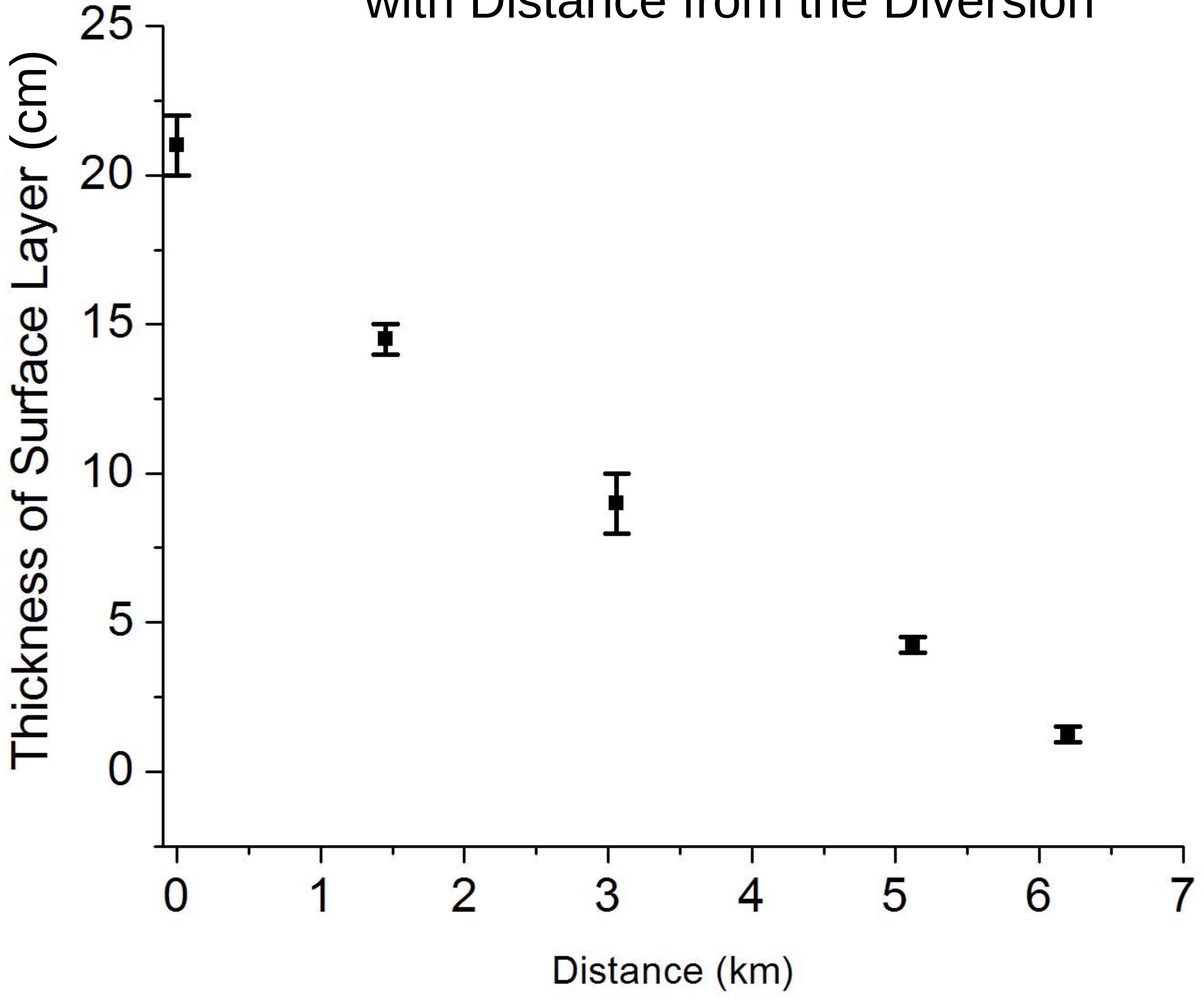
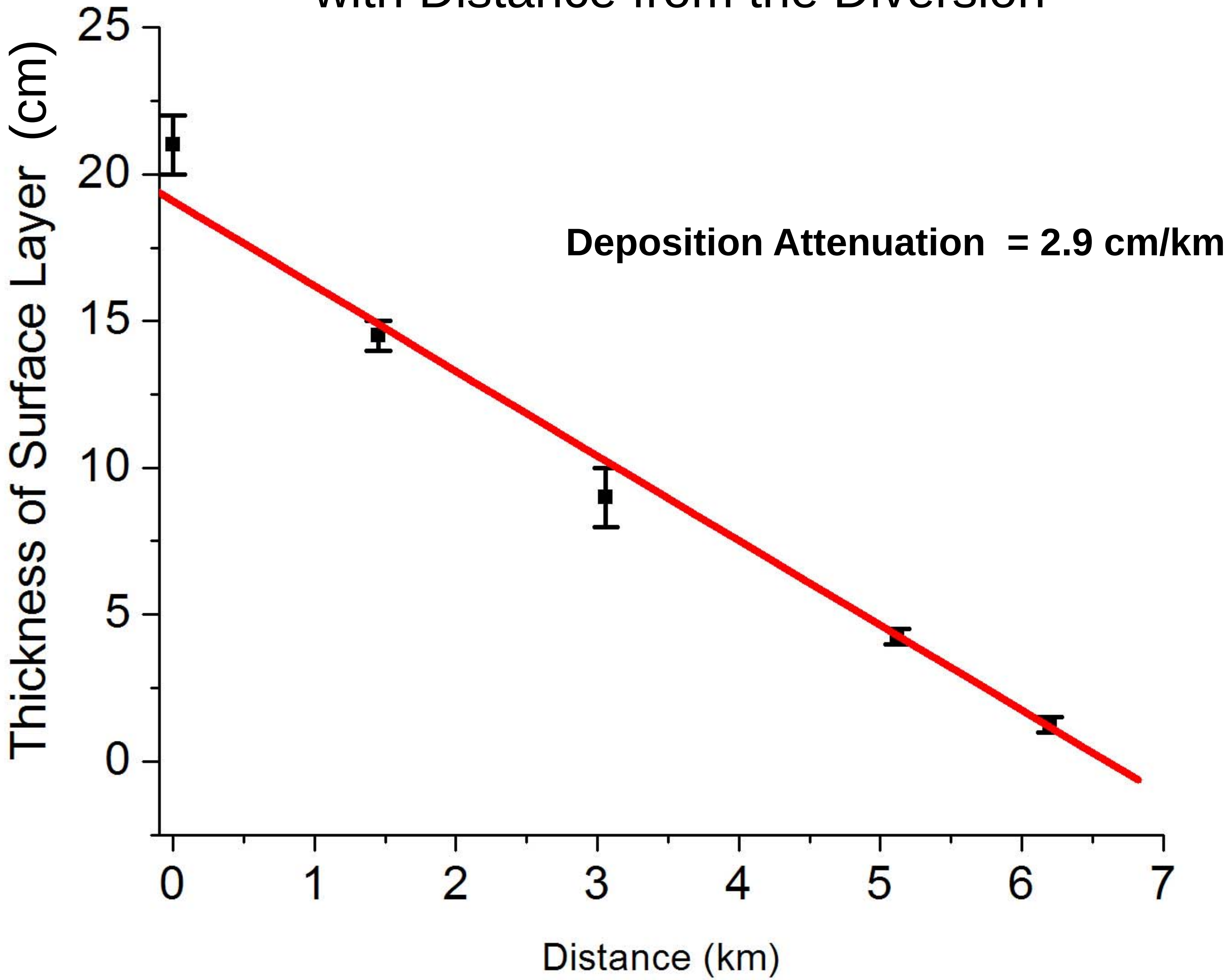
This same surface layer was found in West Bay and ranged from 2 -25 cm thick


29 11 10.1N, 89 18 02.3W
29 10 32.5N, 89 18 28.3W
29 09 43.6N, 89 18 36.6W
29 08 38.3N, 89 18 52.2W
29 07 39.7N, 89 19 02.0W

West Bay Surface Layer Decreases in Thickness with Distance from the Diversion



West Bay Surface Layer Decreases in Thickness with Distance from the Diversion



Findings

- Sediment deposited in Pass-a-Loutre and West Bay during the spring 2008 flood ranged from 2~25 cm.
- The thickness of this layer decreases with distance from a river source. The manner in which it decreases varies between two study locations.
- Event-scale deposition can be compared to historic rates of sediment deposition (~1.6 cm/yr*) and regional rates of relative sea level rise (0.5 – 3.5 cm/yr**).

*Wilson (2006), Wilson and Allison, submitted

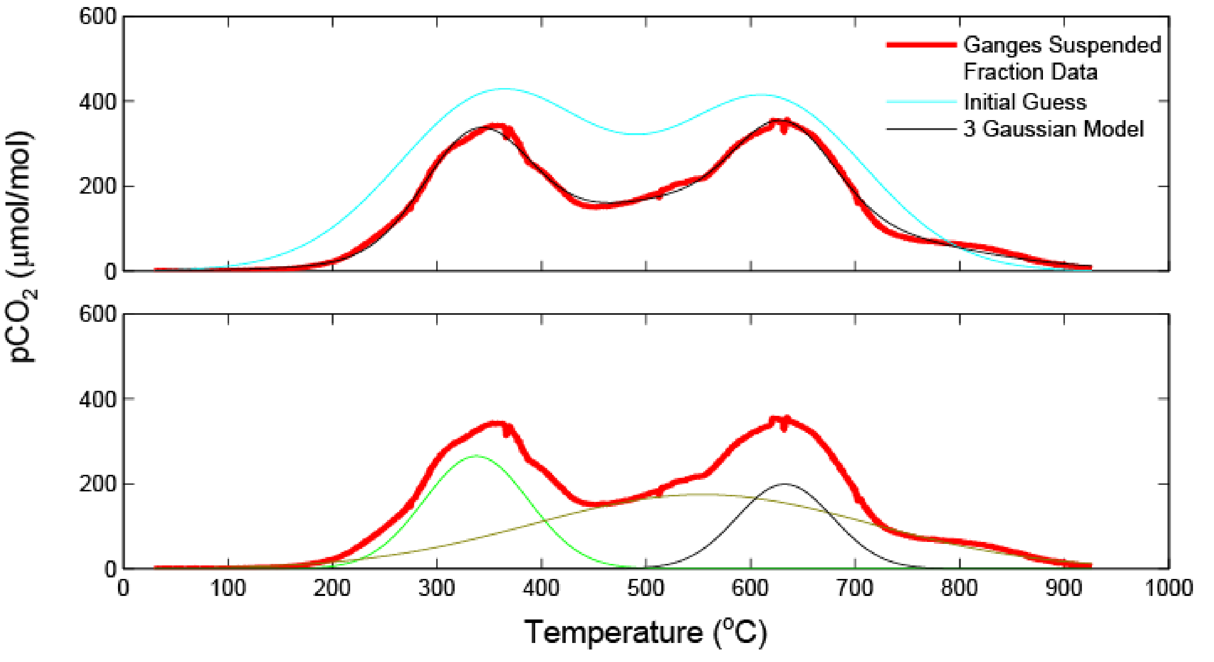
** Reed et al., (2002), www.tidesandcurrents.noaa.gov, Gonzales and Tornqvist, 2006)

River Derived Bulk Organic Carbon: A Hypothesis

Differences in thermochemical stability of the various components of acid insoluble organic carbon (~bulk organic carbon) can be exploited through programmed temperature pyrolysis/combustion of demineralized sediments to separate components of different ages.

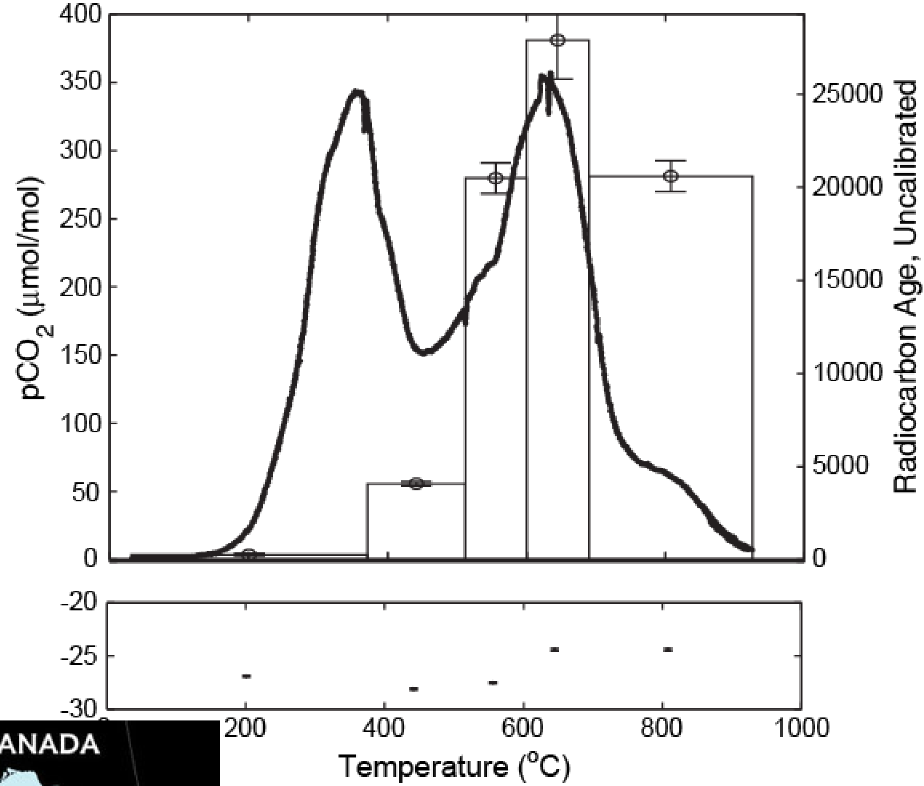
Ganges System Thermograph

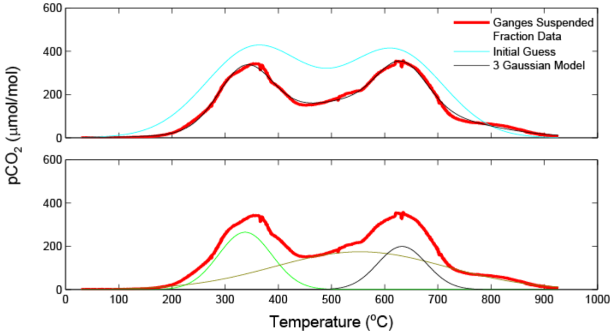
- Separate and distinct major components revealed by slow (5 deg. C per minute) pyrolysis
- CO_2 trapped and prepared for radiocarbon analysis



Inter-system Comparison

- Two distinct age groups relate to the separate peaks in CO_2 generation
- Approx. half of POM is petrogenic – carbon sink potential is reduced
- Mississippi similar?





Status

- 200L of water collected from Mississippi in Spring 2008
- Bedload surface sediments, push cores and vibra cores in collected in lower river and associated bays and wetlands
- Second generation pyrolysis system under construction at Tulane, improving upon the first generation at the National Ocean Sciences Accelerator Mass Spectrometer at WHOI.

Implications and future directions

- River floods can deliver large sediment loads to coastal wetlands. However, their effectiveness at maintaining wetland accretion on a subsiding coast depends on the reoccurance period of depositional events.

- Floods from large rivers may play a large role in the delivery of carbon to the world's oceans.

- Decadal scale depositional events may play a key role in the development of river-dominated deltas.

- Continued river observing planned on seasonal time scales.

Dynamics of the 2008 Lower Mississippi River Flood Conference

- Hosted by LEAG at Tulane University, October 17, 2008
- 11 Oral Presentations from the USGS, Tulane University, LUMCON, University of Texas, University of New Orleans, Lake Pontchartrain Basin Foundation and LSU.
- Over 50 Participants, including faculty, researchers, and students.
- An article proposal on the Mississippi River Flood has been submitted to Eos and is currently under review.

Many Thanks

- Tulane-Xavier Center for Bioenvironmental Research/LEAG
- National Science Foundation
- University of New Orleans
- Vanderbilt University
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