



BP/FIO Grants Program

Assessing the impact of the Deepwater Horizon oil spill on sediments and benthic communities on the West Florida Slope

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BP oil spill and subsurface plumes

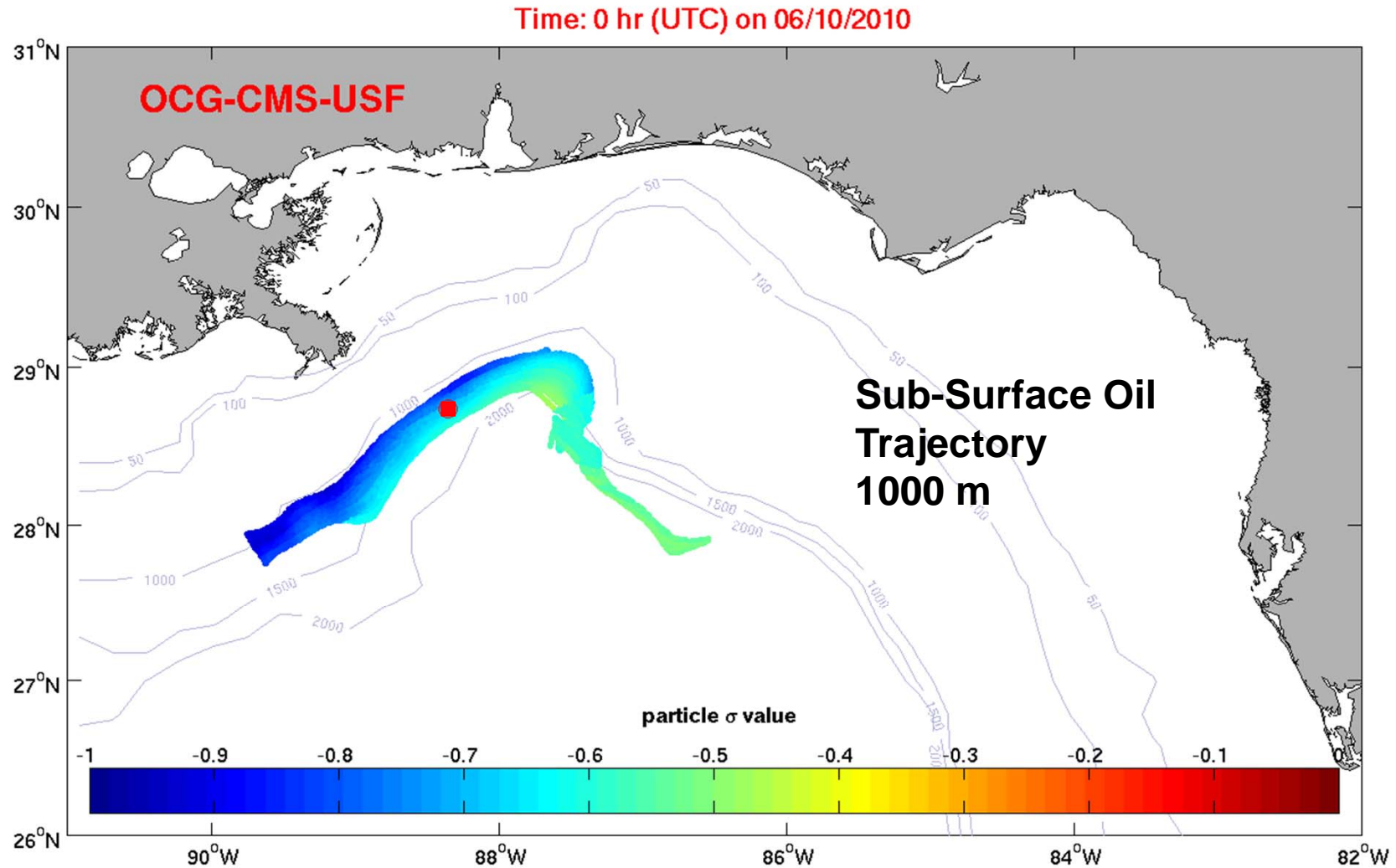
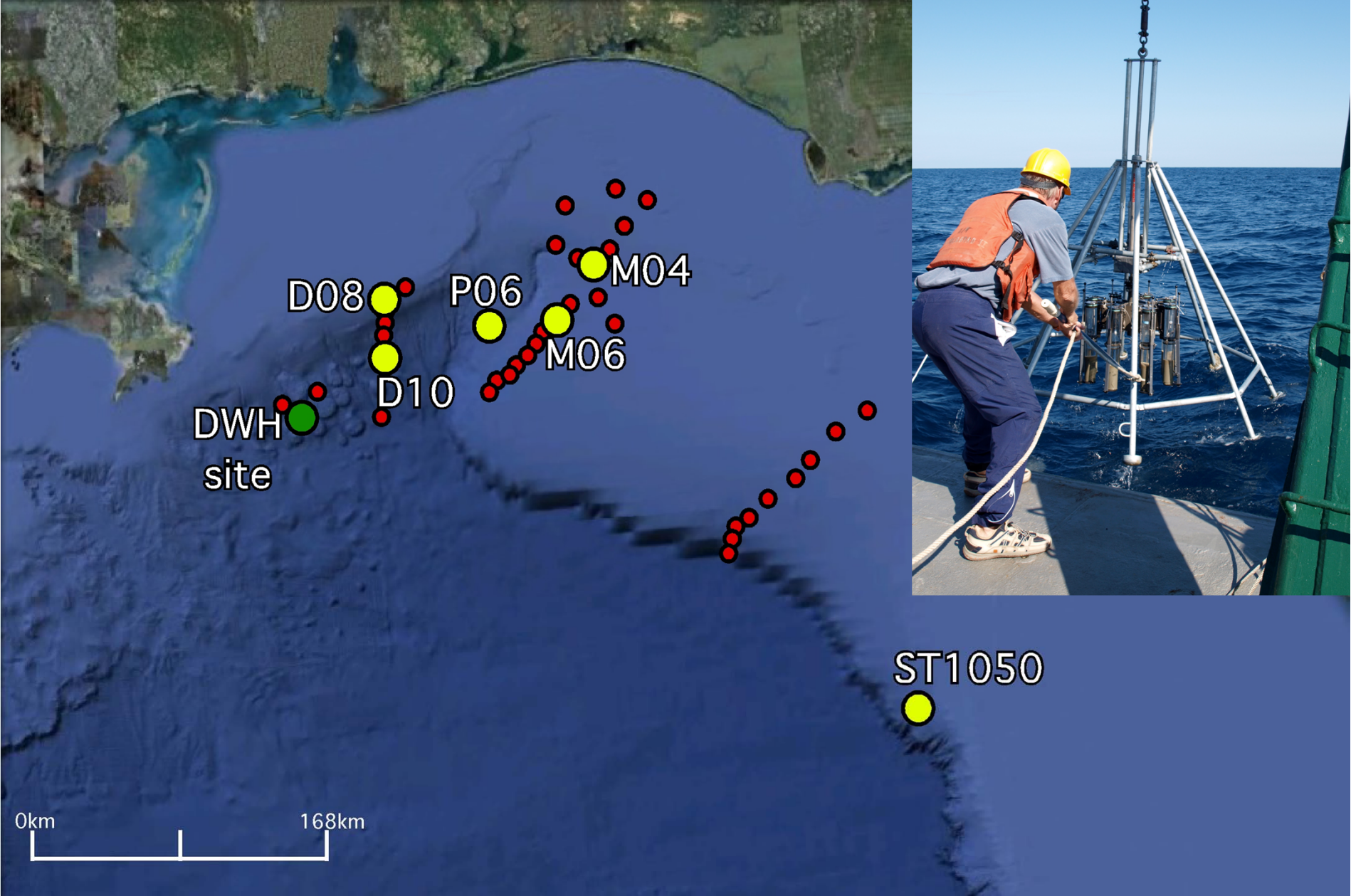
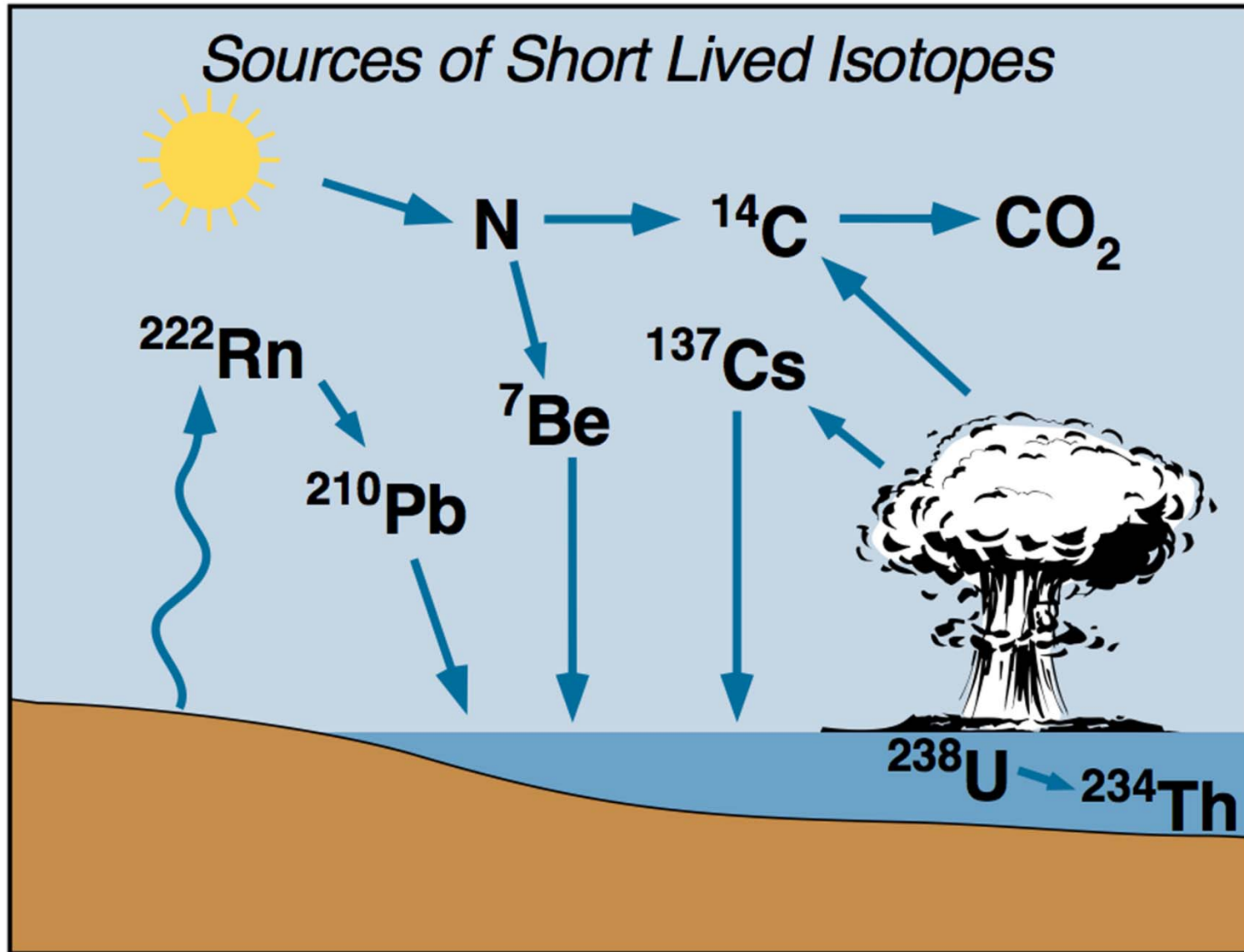


Image from R.H. Weisberg (USF)

Sediment core sampling sites





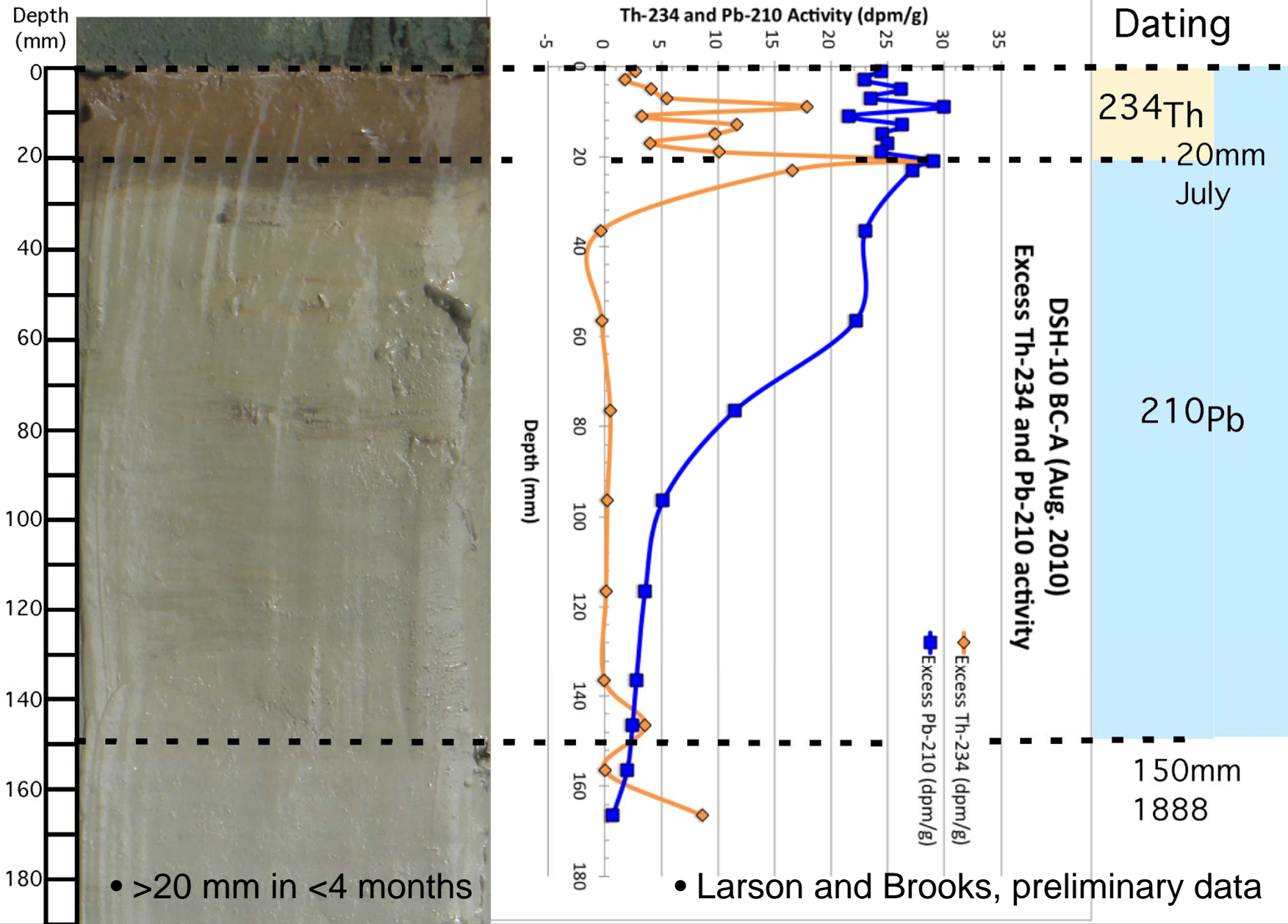
- ^{234}Th half-life 24.5 days => measurable to ~120 days
- ^{210}Pb half-life 22 years => measurable to ~110 years

Photograph
Core Collected Dec. 2010

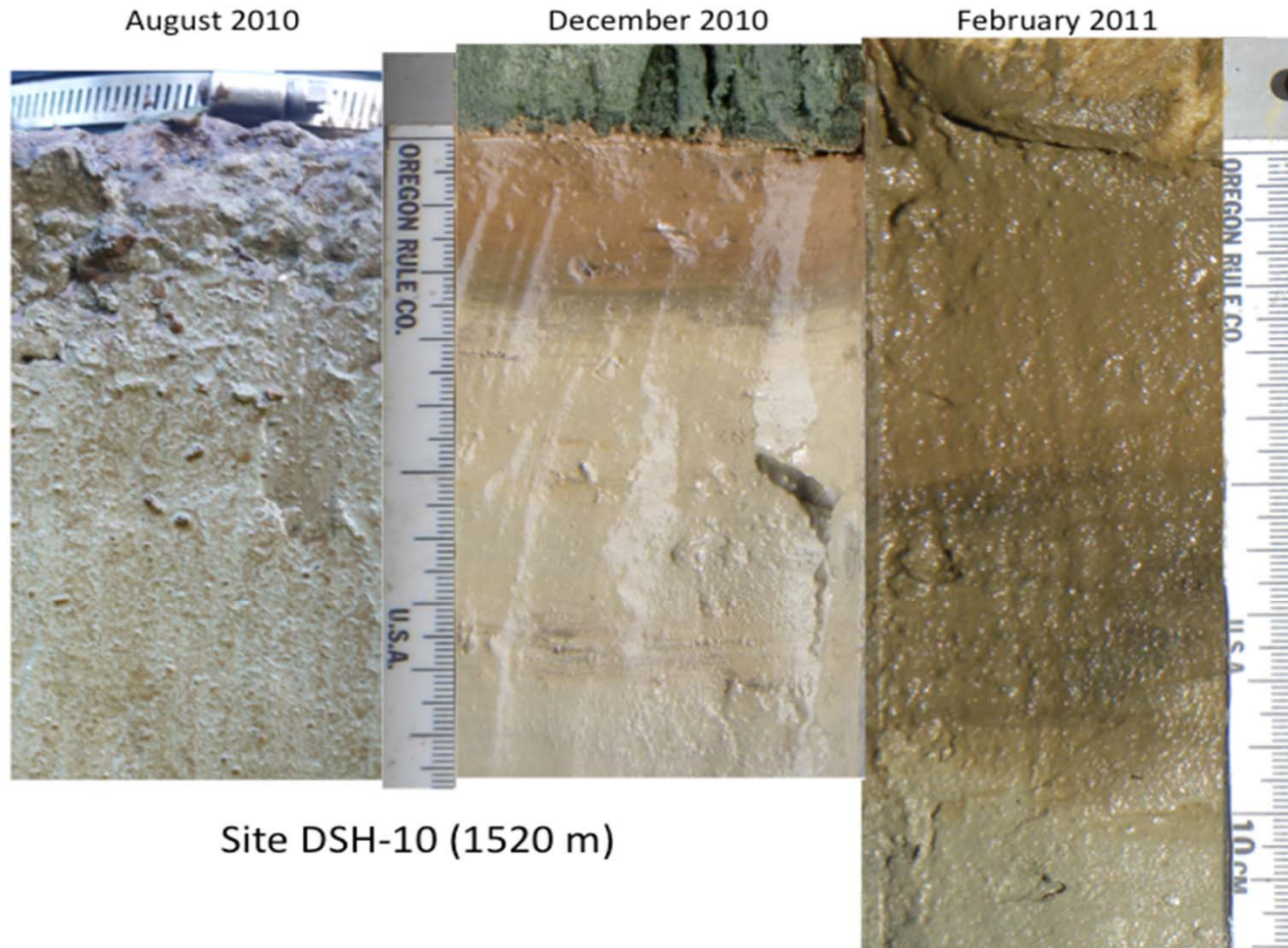
88 W DSH10 box core

Collected Aug. 2010

28 58.6 N
87 52.4W
Water Depth = 1520 m

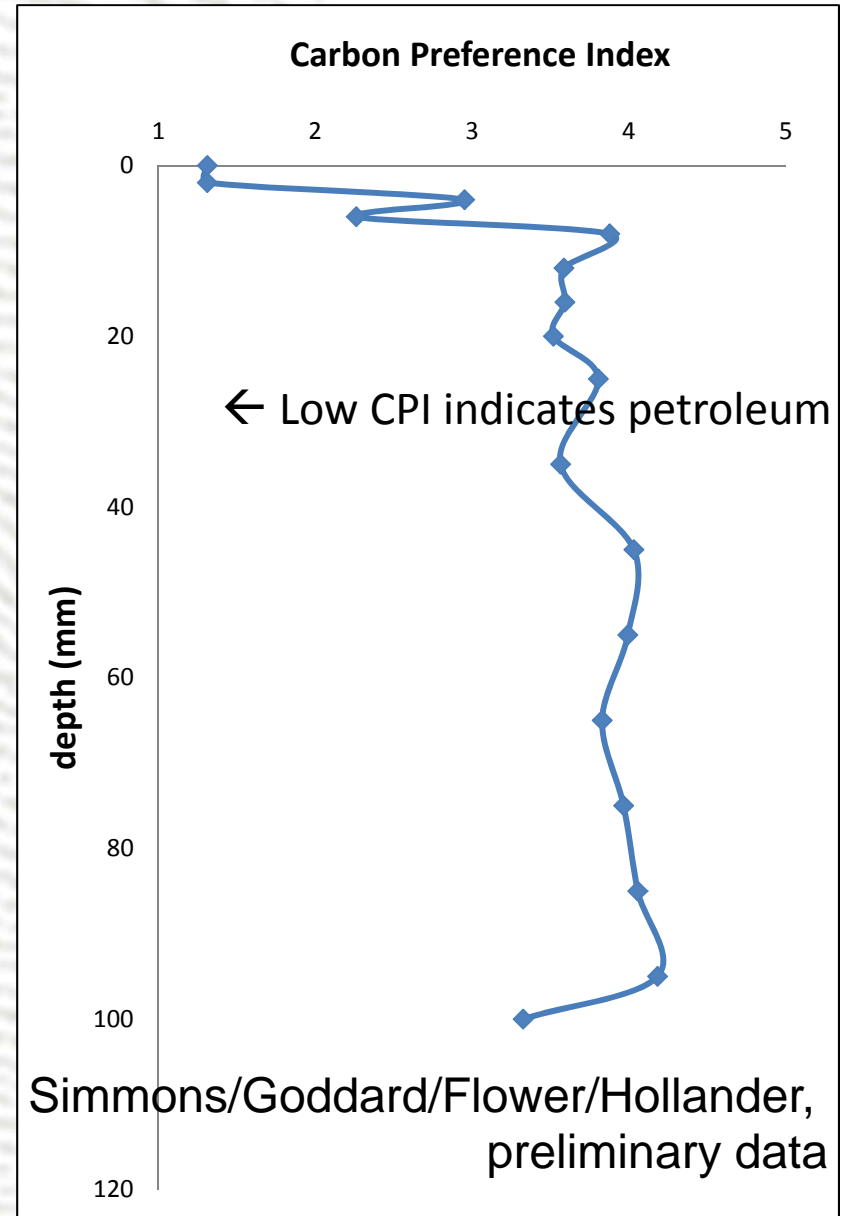
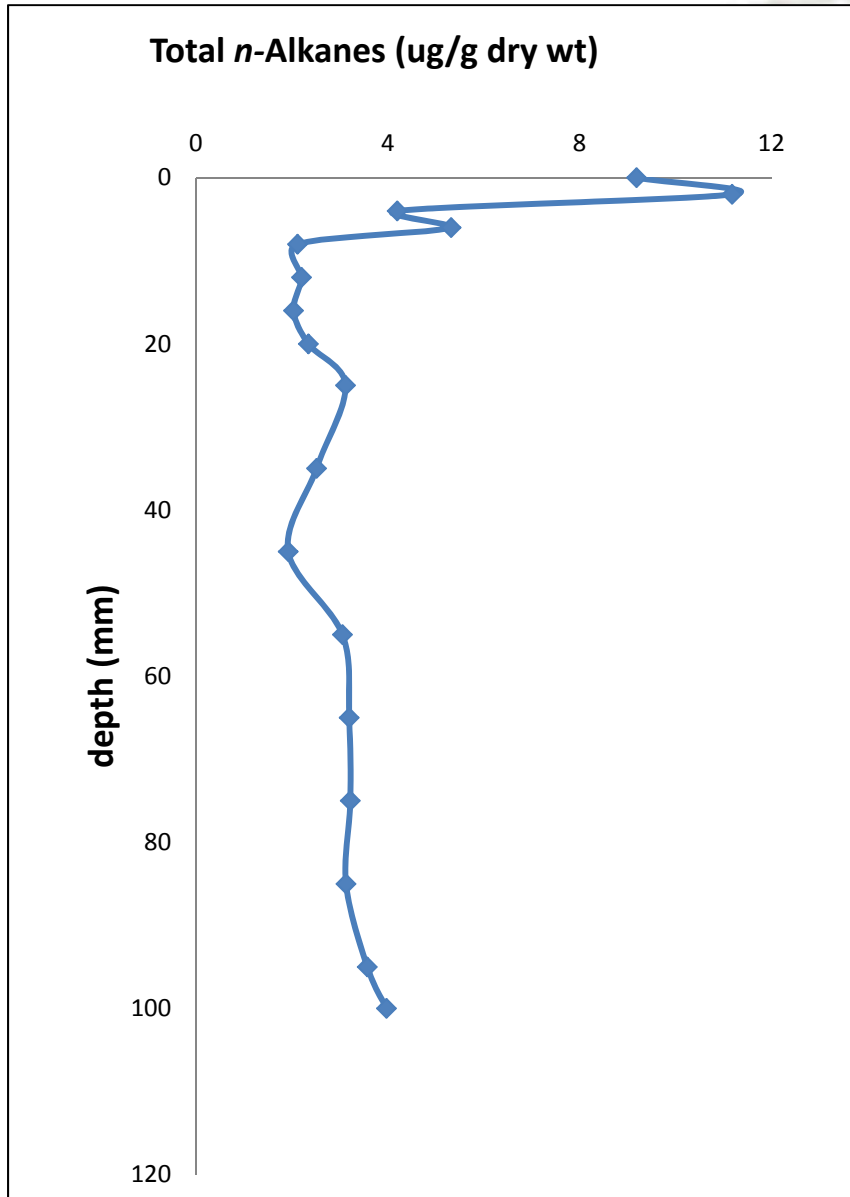


8-9 cm of sediment in <6 months?!

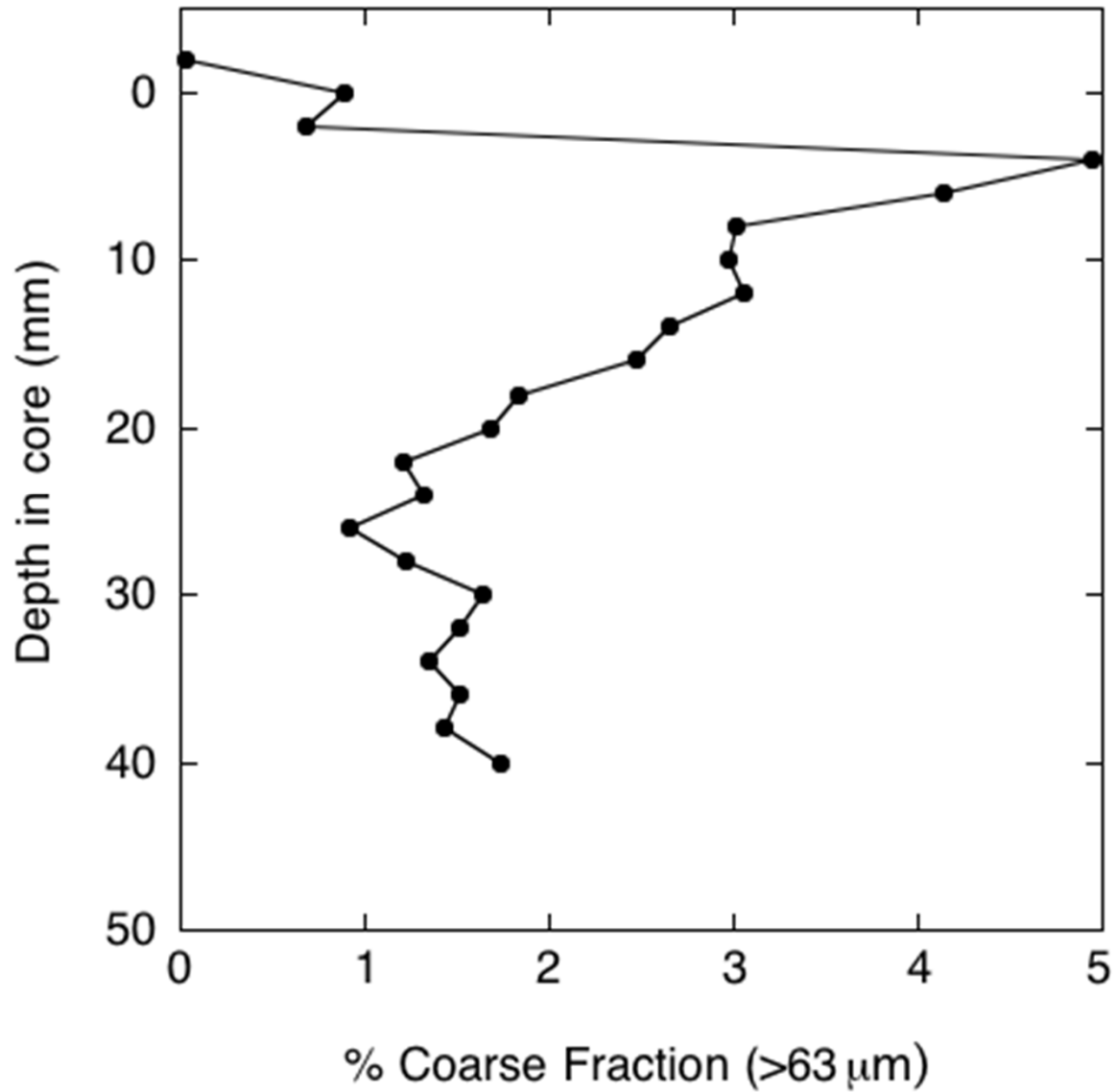


- First dark brown layer appears at 0.6 cm (August), 2-2.5 cm (December), and 8-9 cm (February).

88 W DSH10 box core

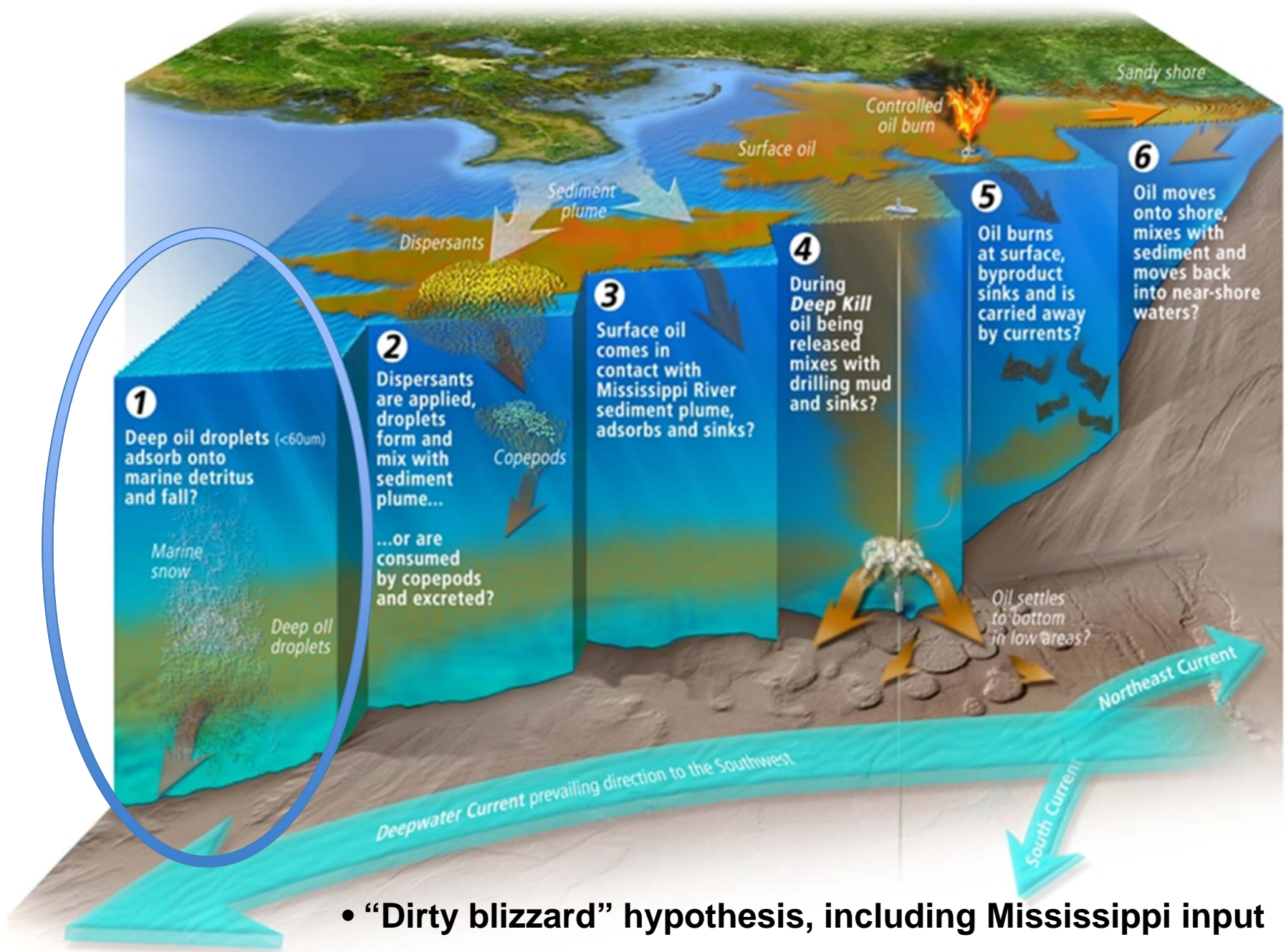


88 W DSH10 grain size (December)



Brown et al., preliminary data

Potential Scenarios for Oil in Sub-surface Areas



- “Dirty blizzard” hypothesis, including Mississippi input

Effect on benthic biota: DSH-10 box core top



Cibicidoides wuellerstorfi (normal)

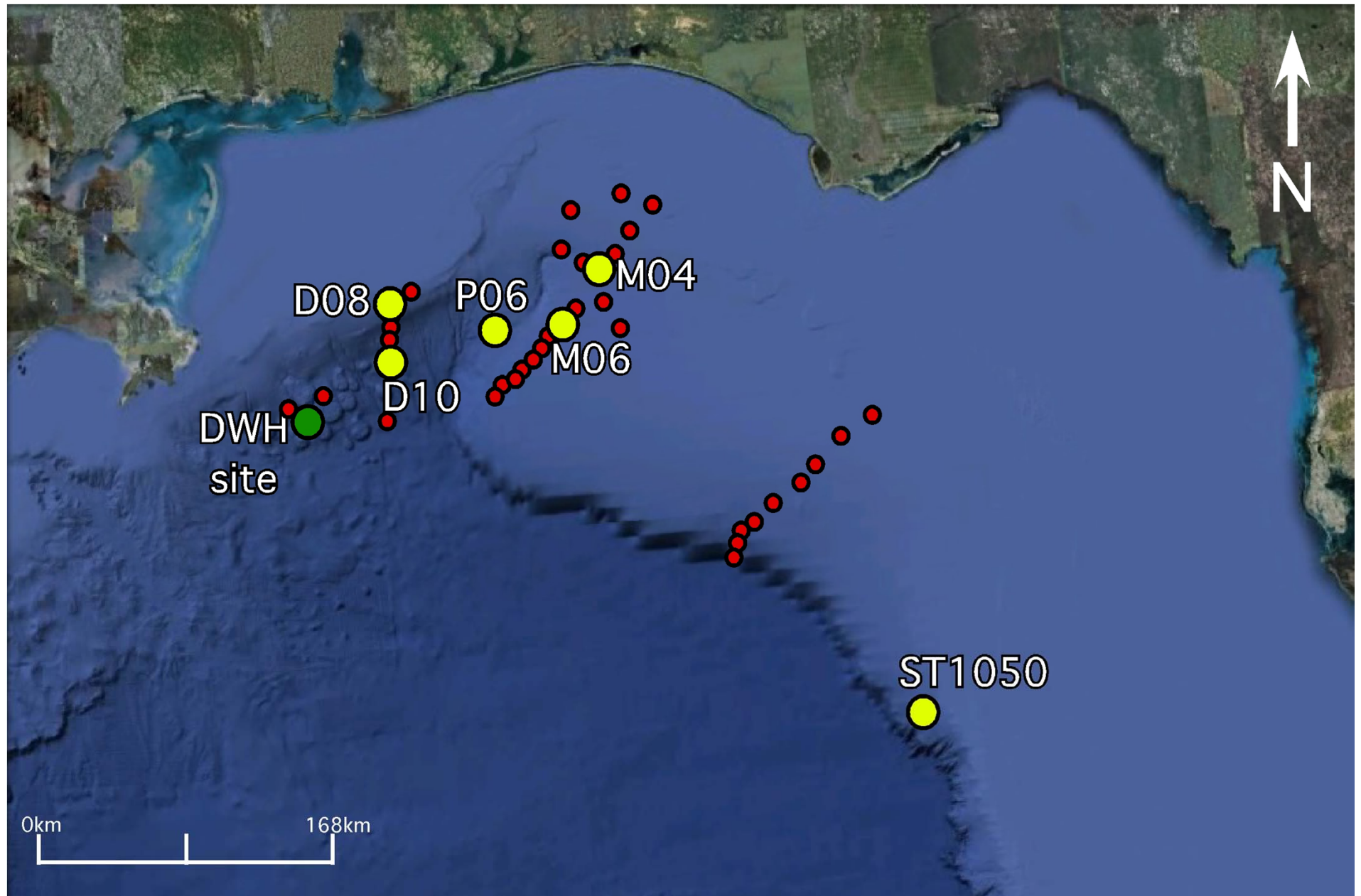
Brown and others, preliminary data



Cibicidoides wuellerstorfi (deformed)

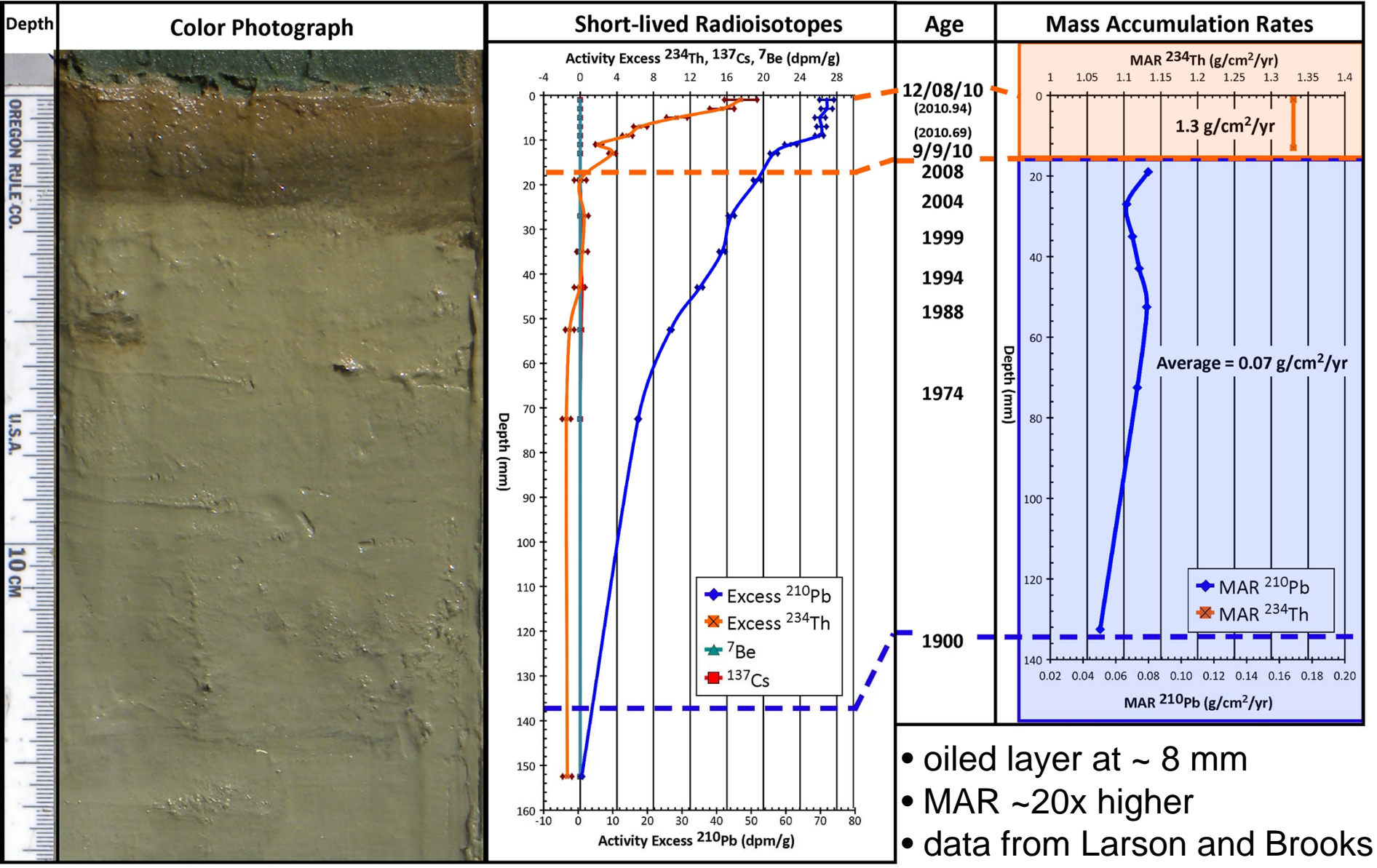
- 8 of 42 specimens deformed
- Benthic $\Delta^{14}\text{C}$ -107‰

Extent of “Dirty Blizzard” effects?



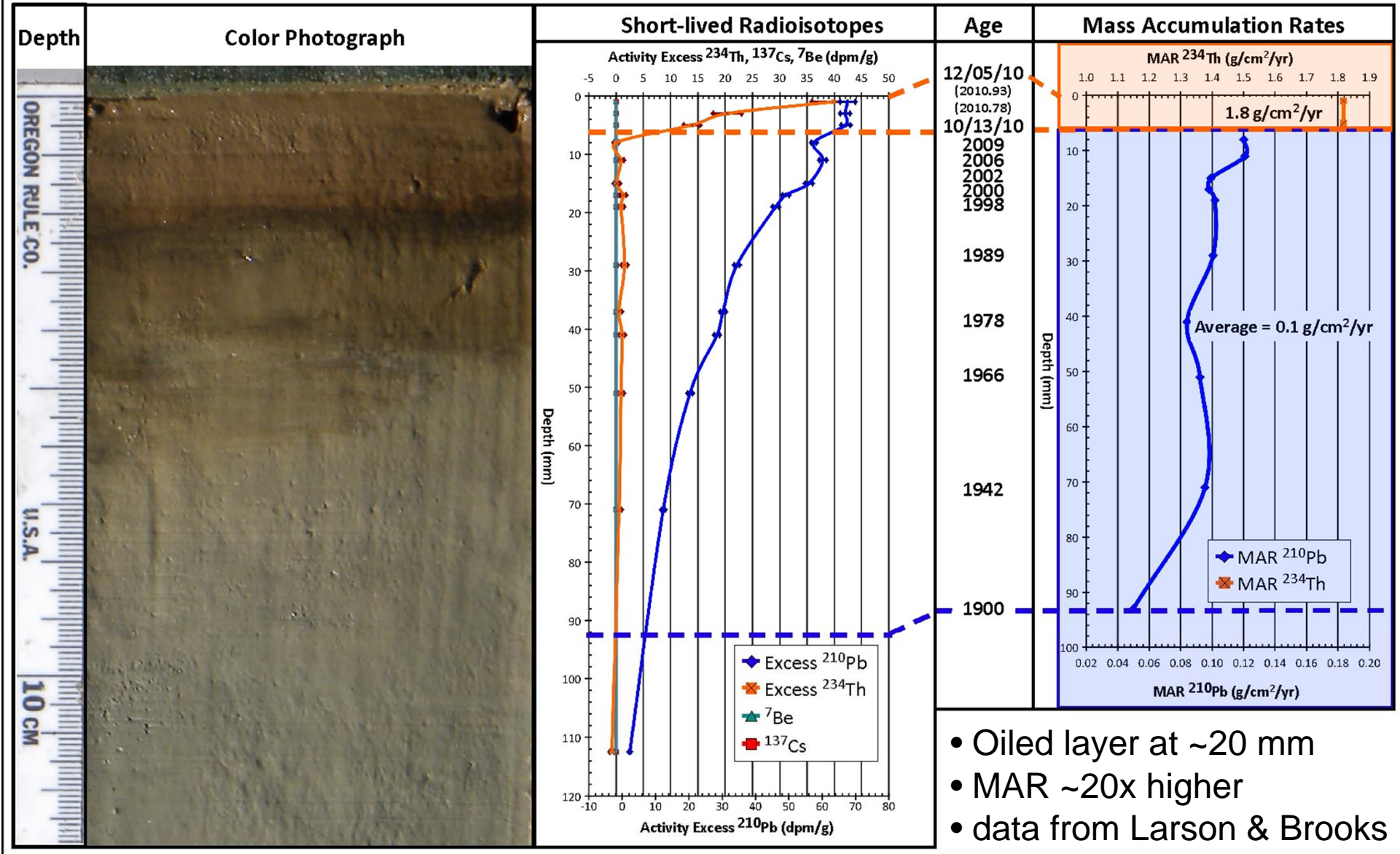
88 W core DSH08

Water Depth = 1143m



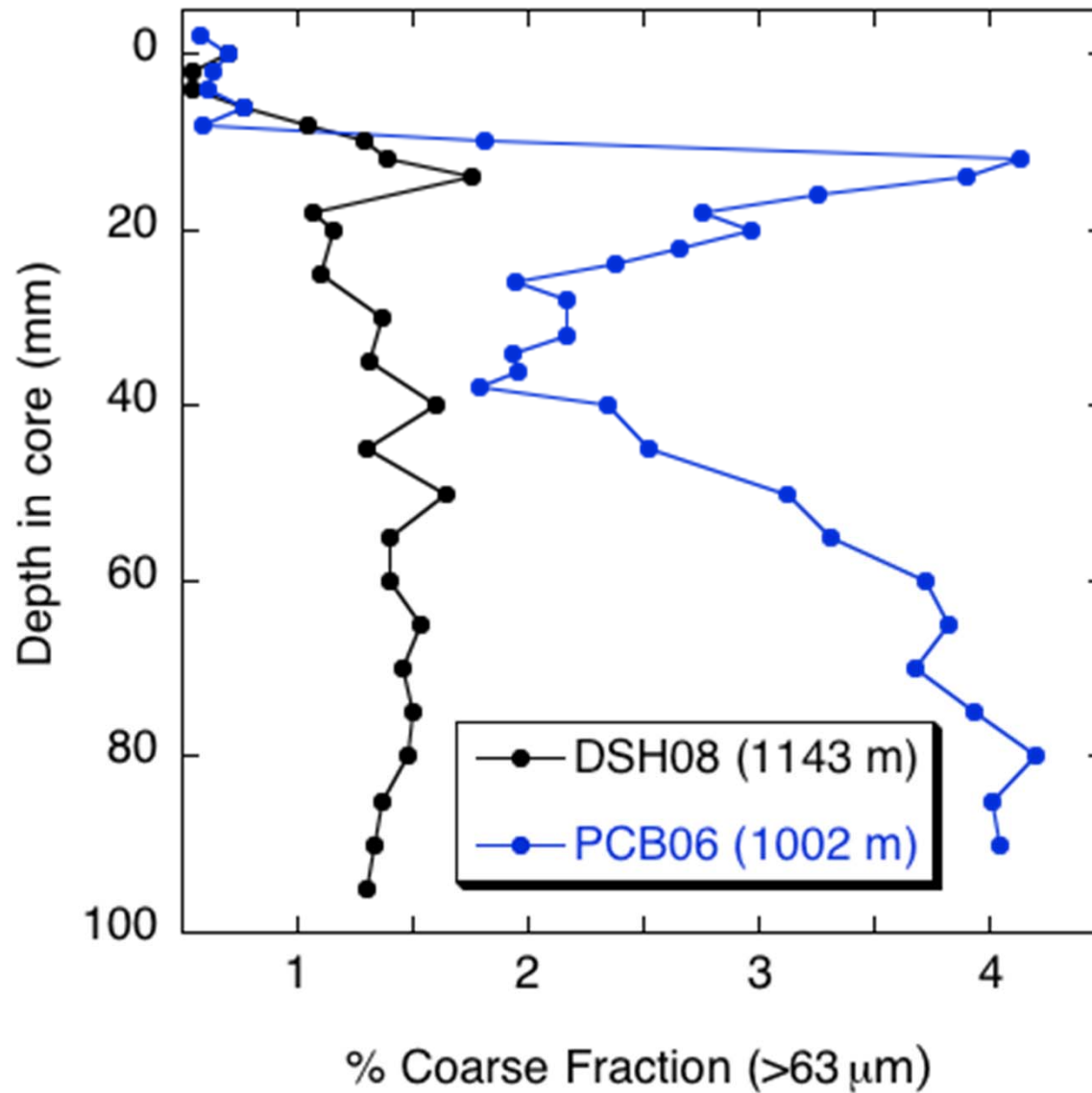
E DeSoto Canyon core PCB06

Water Depth = 1043 m



- Oiled layer at ~20 mm
- MAR ~20x higher
- data from Larson & Brooks

Grain size changes W and E of DeSoto Canyon

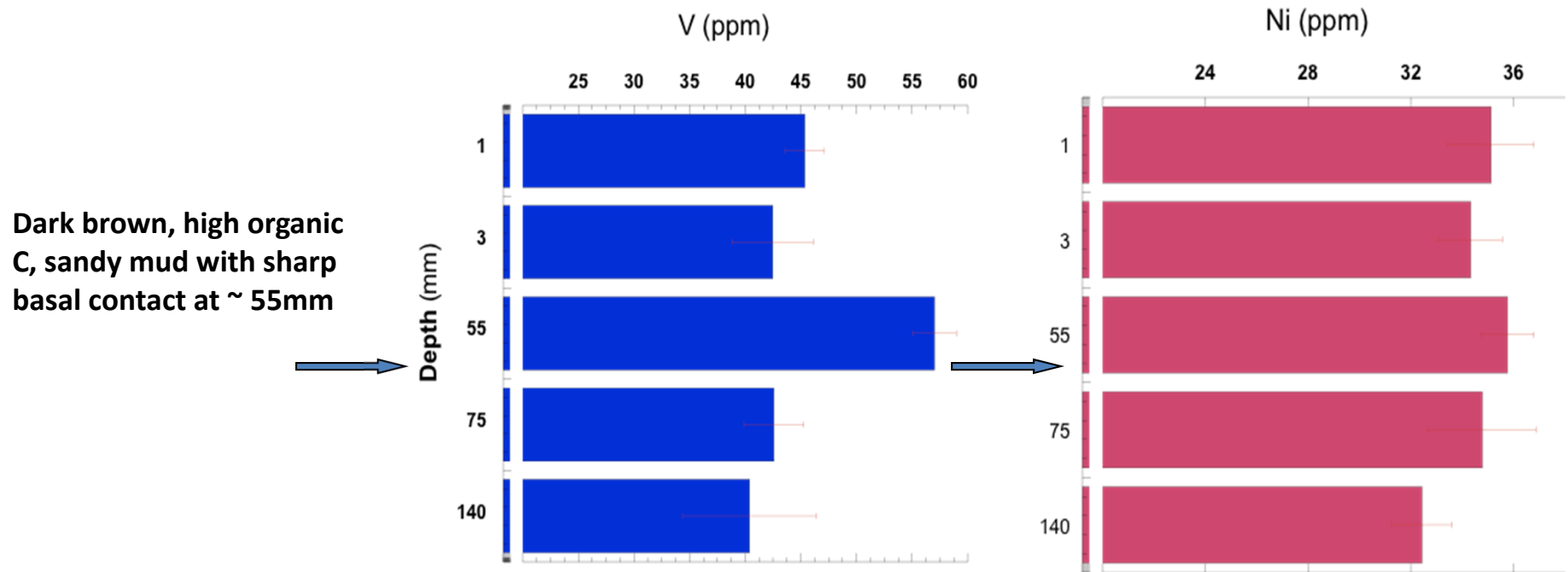


Brown et al., preliminary data

Trace metal enrichment as a tracer for contaminated sediments

- Both V and Ni are enriched in crude oil from Macondo well.
- Modest enrichment is seen in some sediments at and above depth of contamination according to color and textural changes.
- Contaminated beach sands and “sand patties” also enriched in V, Ni

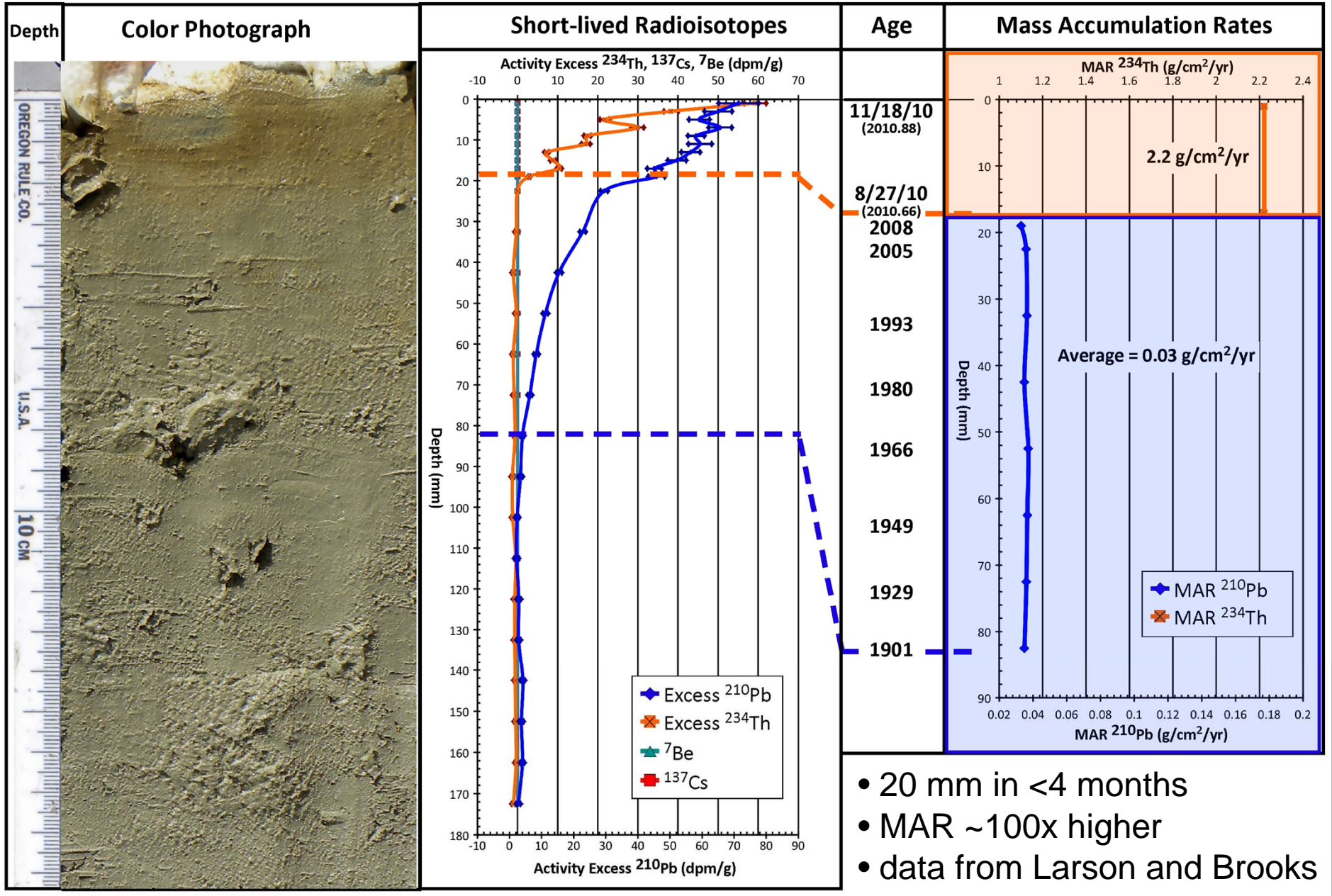
DSH08 Feb 2011 1150 m



Hastings et al., preliminary data

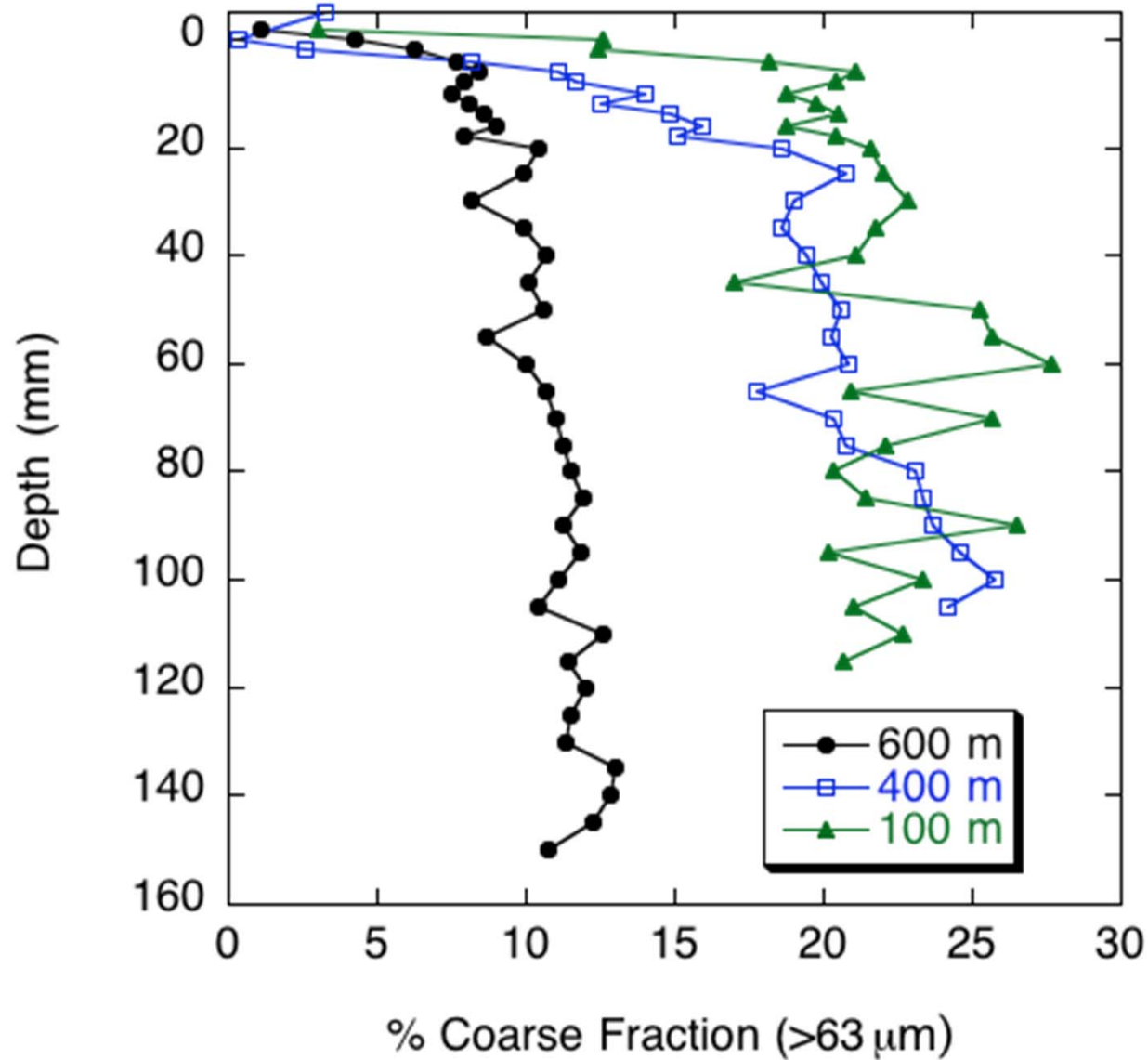
W FL Slope core MC04

Water Depth = 400m



- 20 mm in <4 months
- MAR ~100x higher
- data from Larson and Brooks

Recent grain size decrease on W FL slope



Brown et al., preliminary data

Summary

- Integrated geochemical and biological assessment reveals effects of oil/dispersant on West Florida Slope sediments and benthic communities
- Oiled sediments are found at 1000-1500 m water depth near DeSoto Canyon
- Radioisotope data indicate accumulation rates increased 20-100x in mid 2010
- Grain size data show this material was fine-grained
- Data do not yet allow differentiation between “Dirty Blizzard” and “Toxic Bathtub Ring” hypotheses

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Continuing Work

- Radioisotope dating (^7Be , ^{137}Cs , ^{210}Pb , and ^{234}Th), bulk density determinations, and core photography to assess accumulation rates.
- Molecular and isotopic organic geochemistry to assess the distribution and fate of BP hydrocarbons.
- Ni and V concentrations in surface and pre-spill sediments as a marker of petroleum products.
- Benthic foraminiferal $\delta^{13}\text{C}$ and ^{14}C determinations to assess uptake of hydrocarbons into the food chain.
- Benthic foraminiferal assemblages to assess the effect of BP hydrocarbons and sediment accumulation rate changes on benthic communities.

Preliminary Findings: Sediment Geochemistry

We have capitalized on NSF RAPID funds for an MC-800 multicore sediment sampling system (OCE-1049586 to Flower) and the BP-FIO Grants Program (4710110102) and sampled >50 sites on 6 R/V *Weatherbird II* cruises. This sediment coring system captures the sediment surface with minimal disturbance, and therefore is the best tool to document sediment conditions before, during, and after the BP blowout, including the recovery phase.

- Oiled sediments were documented at water depths of 900, 1000 and 1520 near DeSoto Canyon. Investigation of nearby sites is underway.
- Sites within and near DeSoto Canyon revealed a >100x increase in sediment accumulation rates in mid- to late 2010.
- At Site DSH10 (1520 m) between the BP wellhead and DeSoto Canyon, a <1 cm dark brown surface layer that was clearly oiled in the August core was overlain by a light brown layer 2-3 cm thick in December, and 8-9 cm thick in February 2011.
- Sediments within DeSoto Canyon are commonly laminated, which suggests a lack of benthic organisms to stir up the sediment (bioturbation).
- The percentage of deformed benthic foraminiferal shells increases from a background rate of ~1% to 19% in mid-2010 at the DSH10 site.
- Grain size data on the West Florida Shelf indicate a dramatic decrease in the coarse fraction (>63 μm) from >20% to <3% in the upper 4 mm.
- Ni and V concentrations are elevated (4-22% and 10-32%, respectively) in surface sediments relative to 5 cm depth at sites southeast of DeSoto Canyon.
- Overall, sediments deposited in mid- to late 2010 within DeSoto Canyon consisted of fine plankton skeletal debris, particulate oil, fresh organic matter, and sparse benthic biogenic sediment, leading to the “Dirty Blizzard” hypothesis. However, our existing cores cannot rule out the possibility that oiled sedimentation and its effects were restricted to the DeSoto Canyon.
- Additional cores and continued scientific support is critical to (1) test the “Dirty Blizzard” hypothesis vs. the “DeSoto Canyon conduit” hypothesis and thereby help assess the fate of BP hydrocarbons, (2) document the geographic extent and duration of the pulse in accumulation rates that occurred in mid- to late 2010, and (3) quantify the effects of BP hydrocarbons and enhanced sedimentation on benthic communities and ecosystems in the eastern Gulf of Mexico.