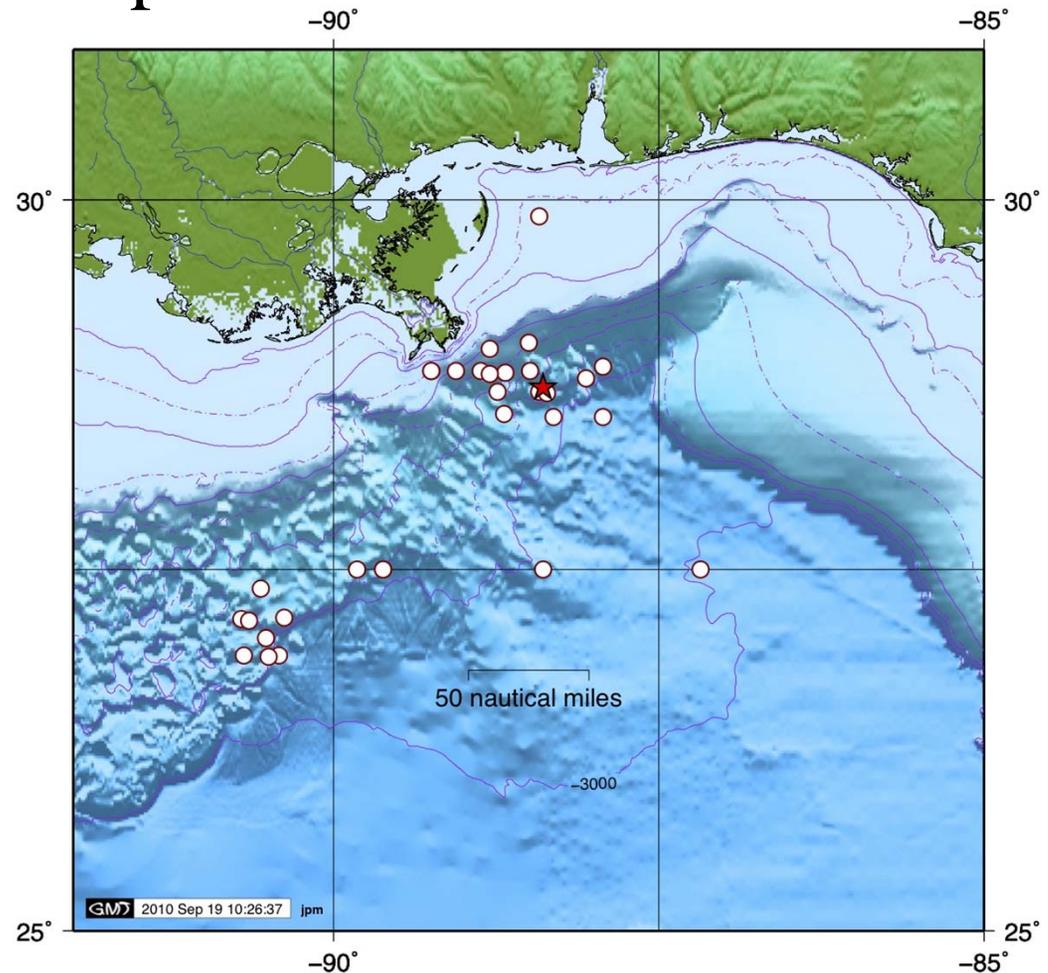

The Deepwater Horizon Oil Spill and Pelagic Food Webs in the Northern Gulf of Mexico



Joseph P. Montoya, Ajit Subramaniam, Vernon Asper, Arne Diercks, Uta Passow, Melitza Crespo-Medina, Mandy Joye, Annalisa Bracco, Tracy Villareal

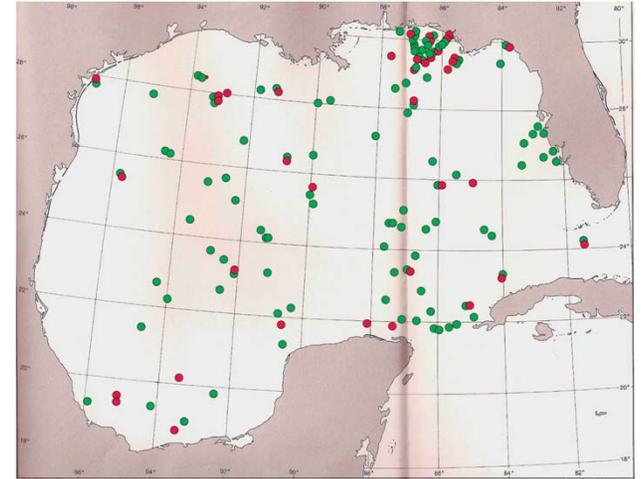
Plan for Today

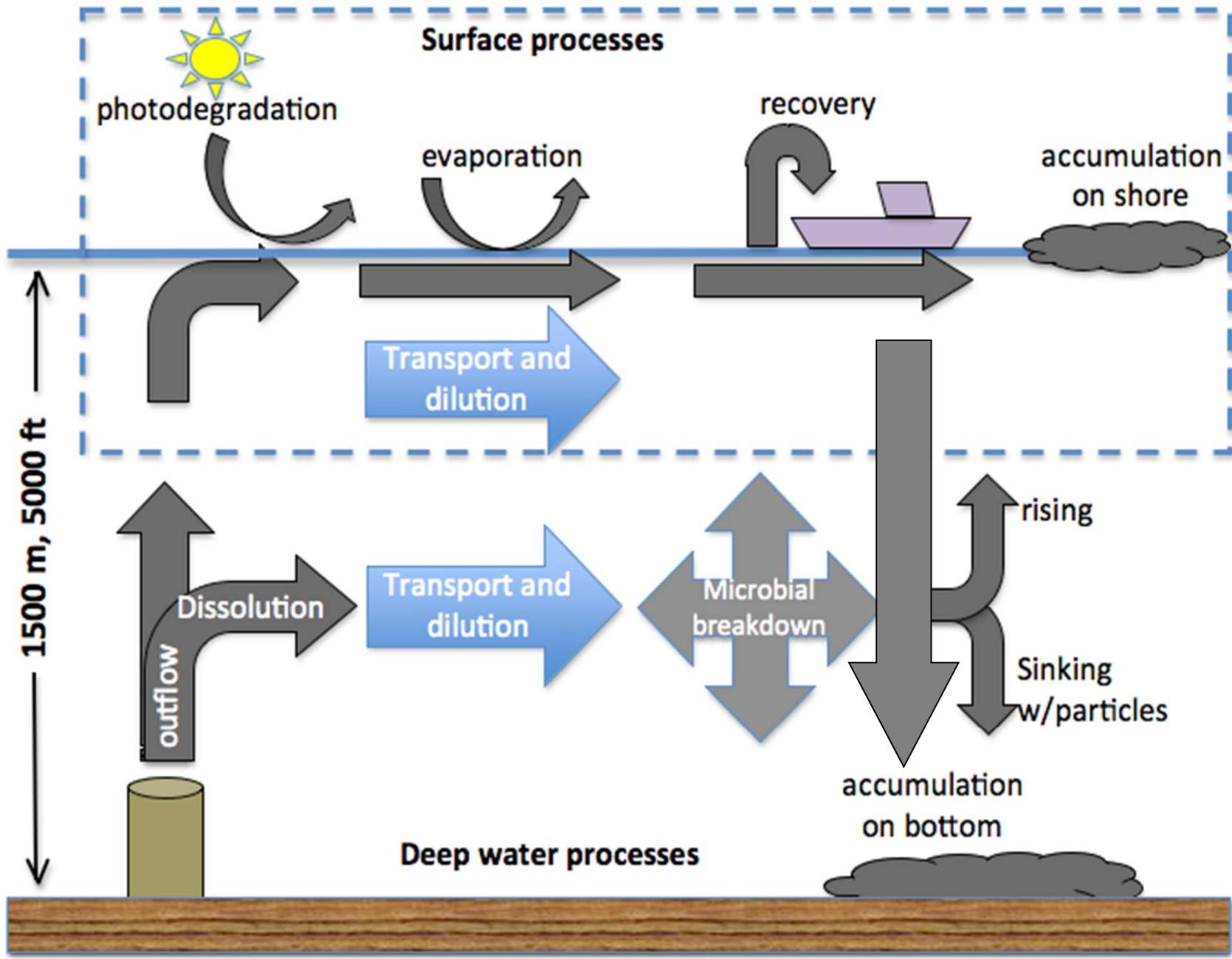
- OC468: 21 Aug – 16 Sept 2010
- Traces of oil
- Isotopic Traces
- What next?



Oceanus 468

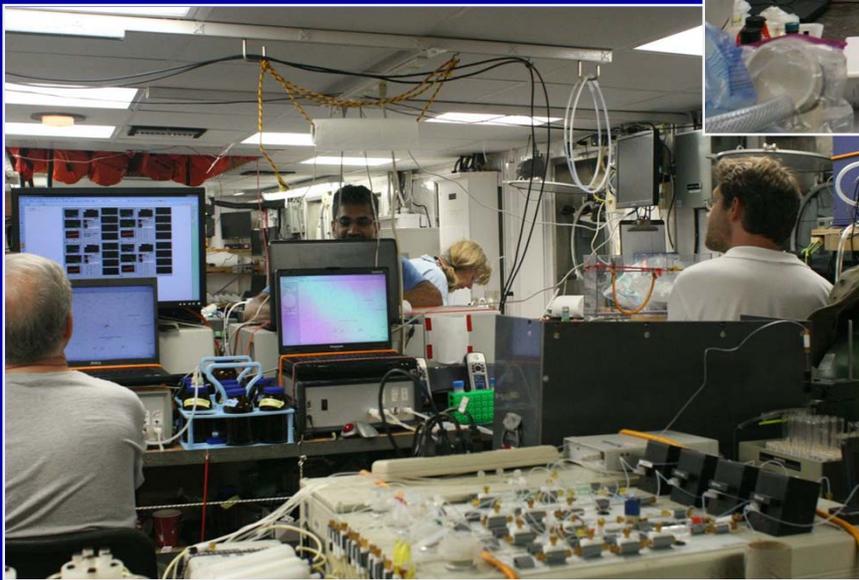
- Original plan
 - N supply via the Mississippi plume, advection, mixing
 - N_2 -fixation, N movement into the food web.
- Retasked cruises
 - Oil distribution and impacts throughout the water column
 - NSF-RAPID recipients
 - R/V Cape Hatteras





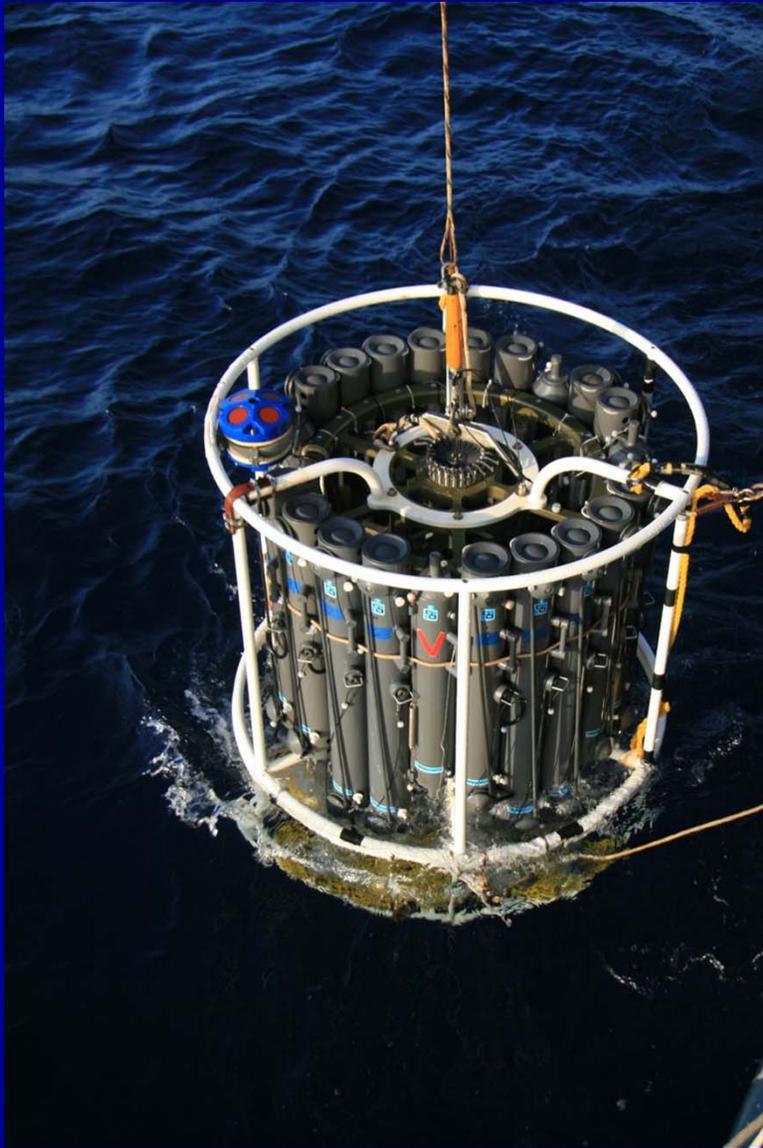
Slide prepared by Andy Juhl and stolen from Ajit Subramaniam, LDEO

Shipboard Party



- GT, UGA, LDEO, USM, UCSB, ECU, UMD

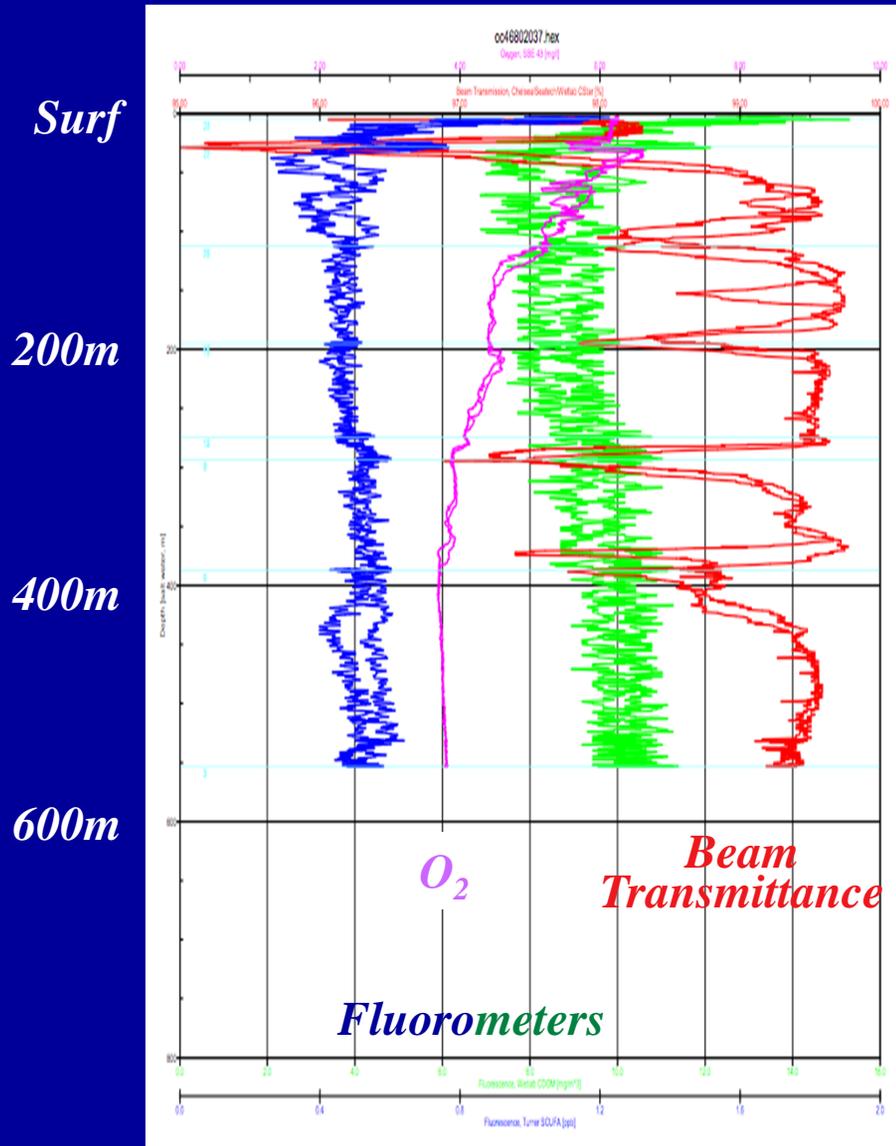
Water Sampling

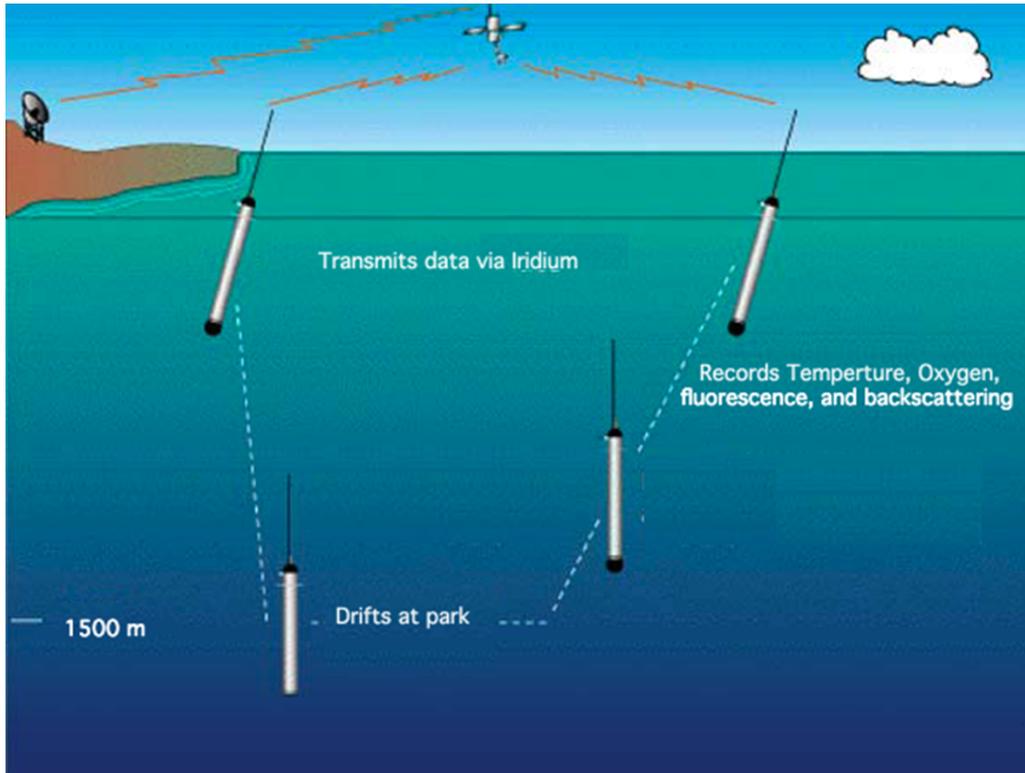


- Hydrographic properties
- Fluorescence
- Beam transmittance
- ADCP
- Nutrients
- Gases
- Particles

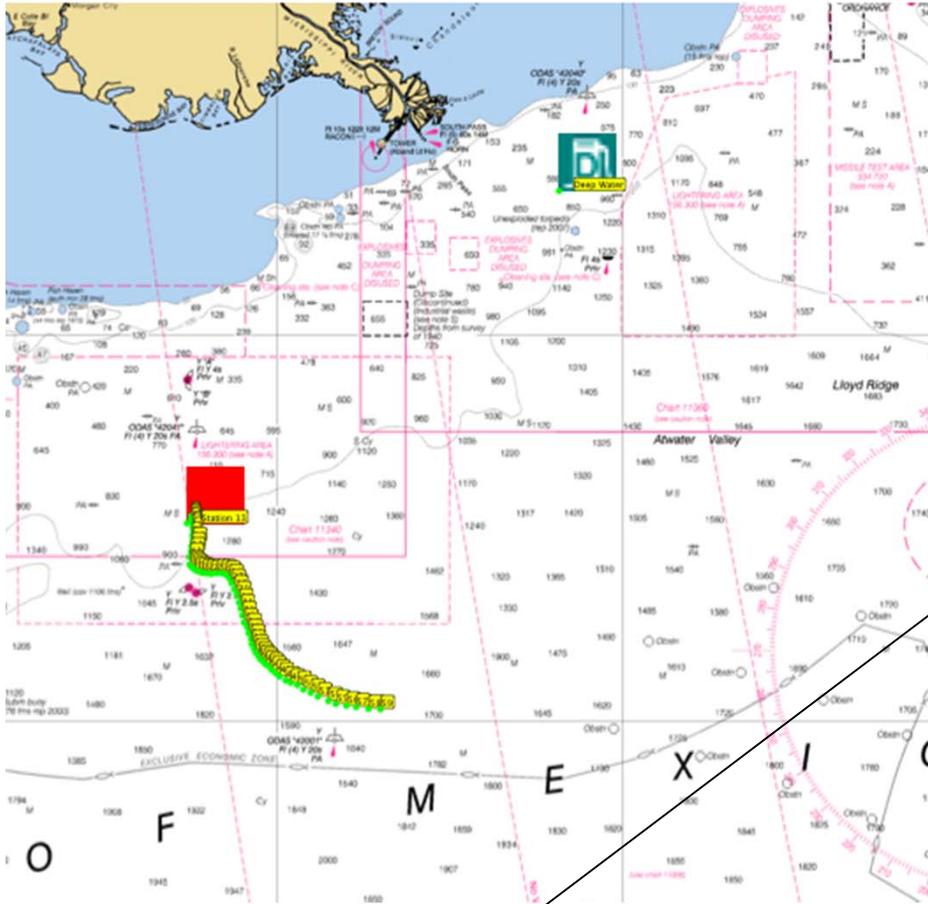
Subsurface Layers

- Coherent features extending tens of nautical miles
 - Low beam transmittance
 - High particle concentrations seen in camera deployments.

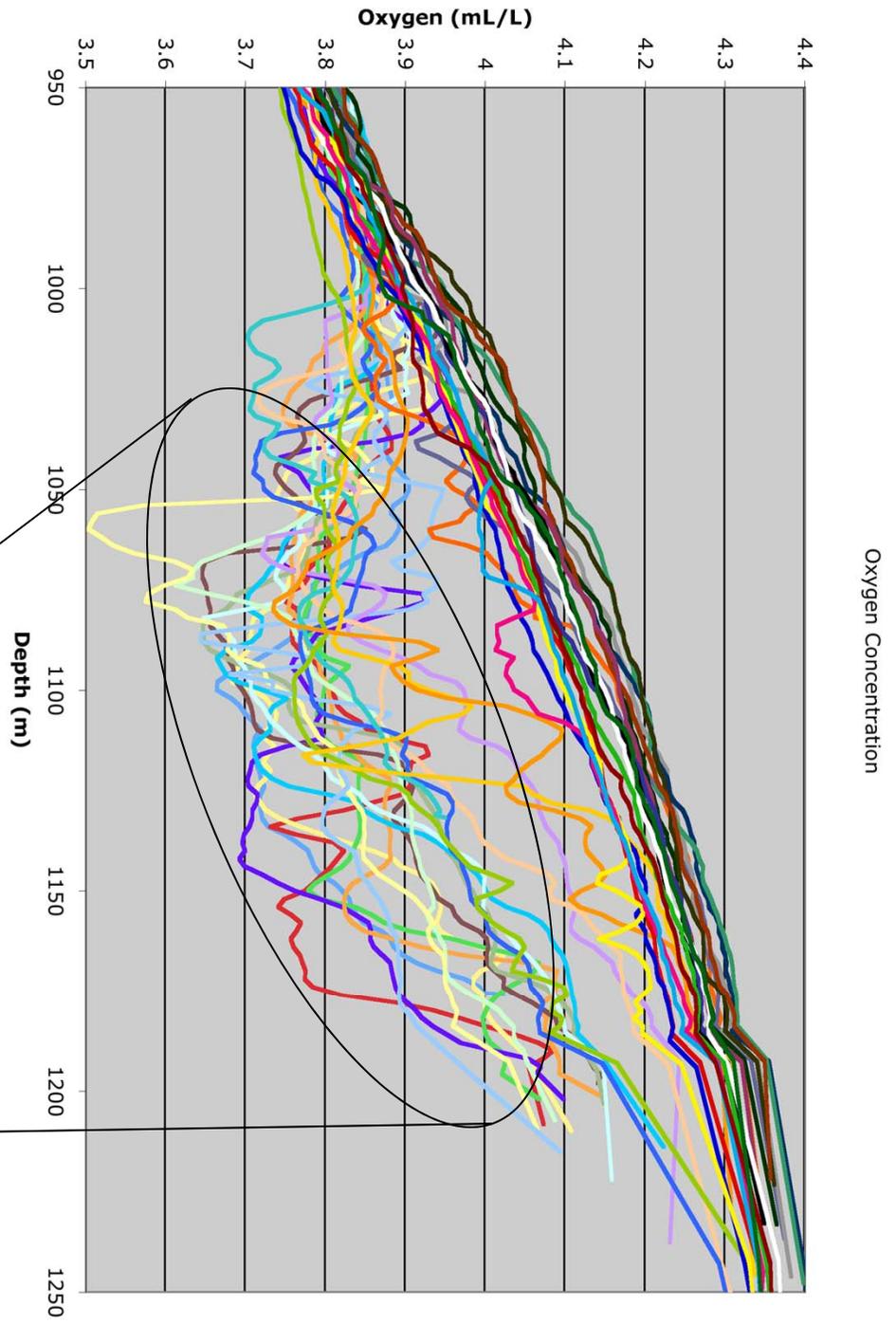




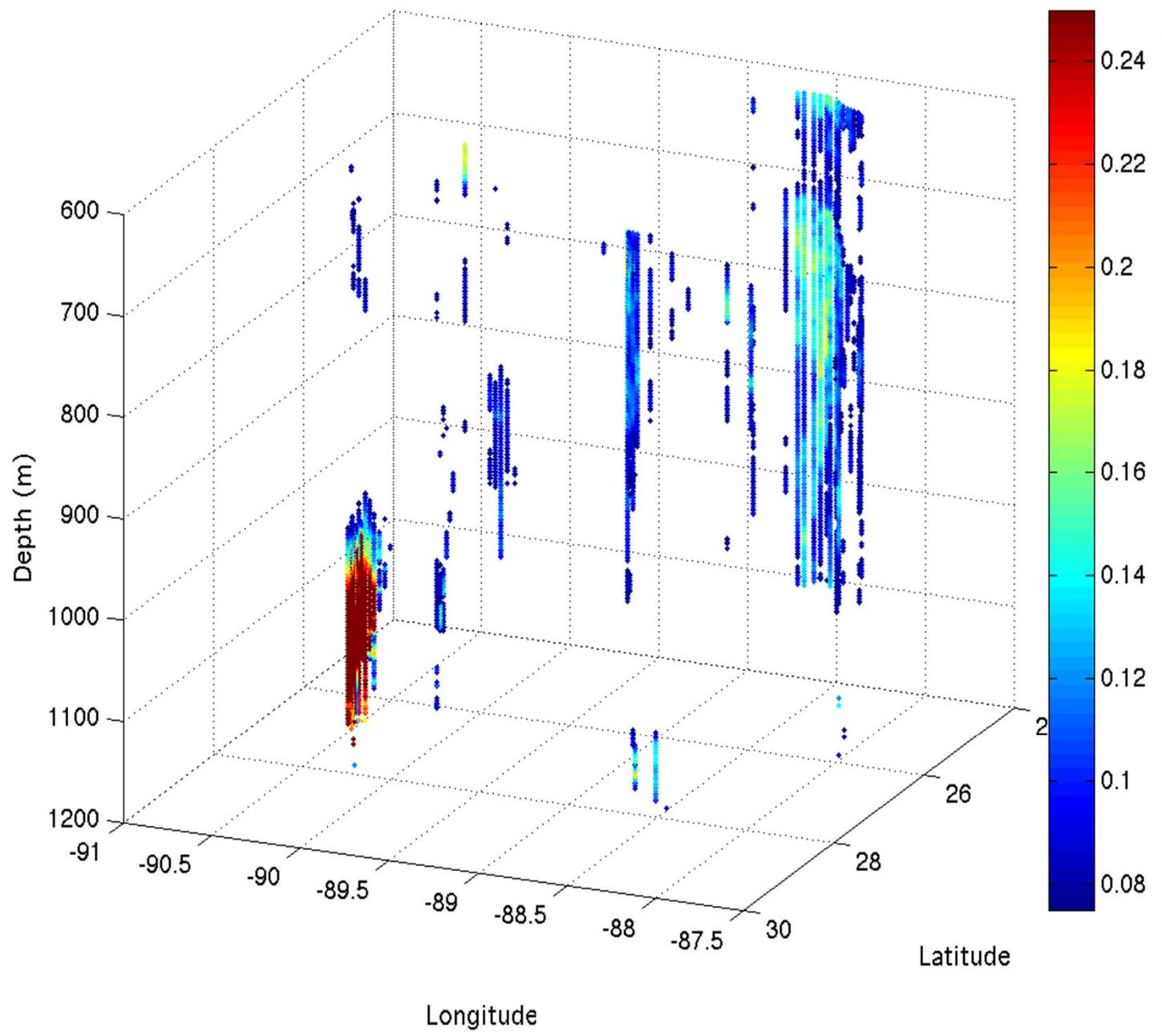
POGO and BOBO were APEX floats deployed in the Gulf on 18th and 28th August. We lost contact with POGO on the 8th of December after it had delivered over 100 profiles. BOBO was successfully recovered on the 21st Dec. after it had done over 200 profiles. The magnitude of DO anomalies was calculated by comparing each profile to a mean of neighboring non-anomalous profiles. DO anomalies of up to 0.58518(mL/L) were discovered at distances of up to 317 km from the wellhead and as late as 100 days after the wellhead was capped.



Persistent traces
of oil plumes past.



Oxygen Concentration

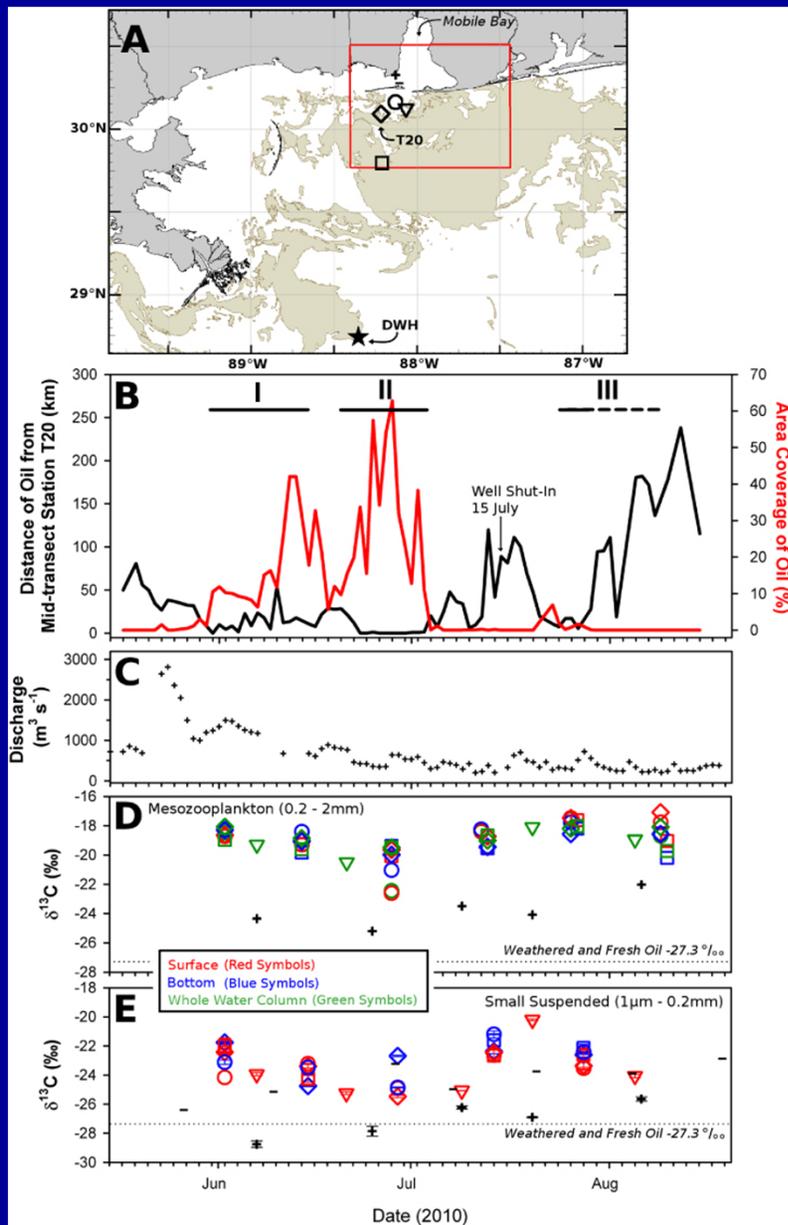




Particle Samples Brown/yellow filters at depth.

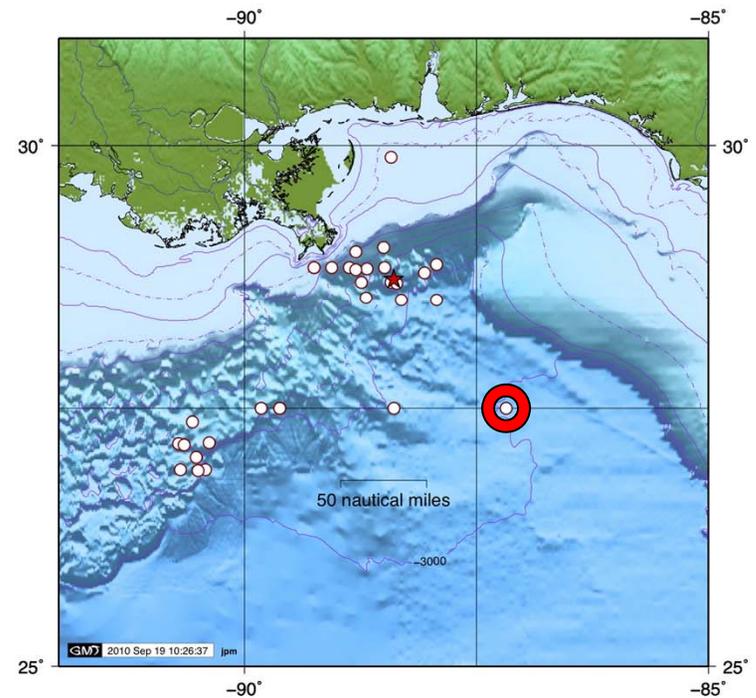
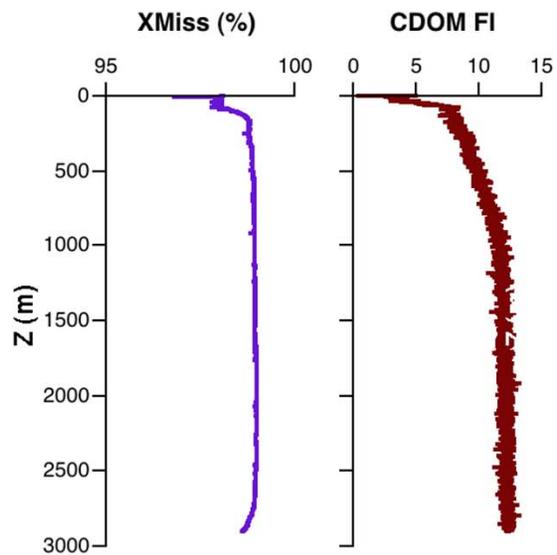
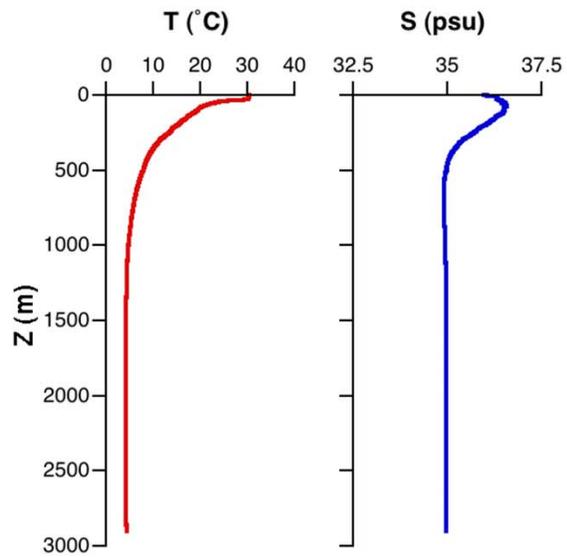
$\delta^{13}\text{C}$ and Oil

- Graham et al. 2010
 - Environ. Res. Lett 5: 45301 (6pp)
- Low $\delta^{13}\text{C}$ in nearshore plankton associated with presence of surface oil slicks.
- Tracer for oil-derived C moving into the food web.



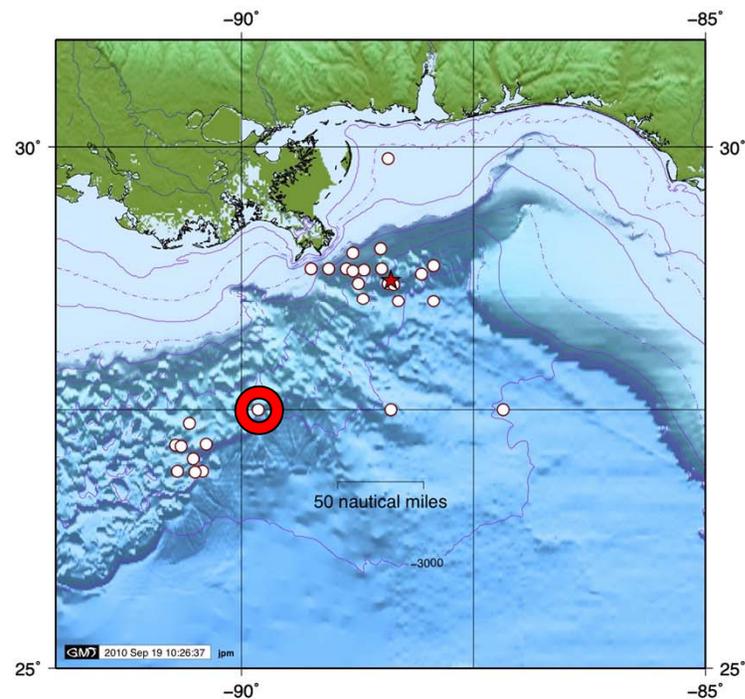
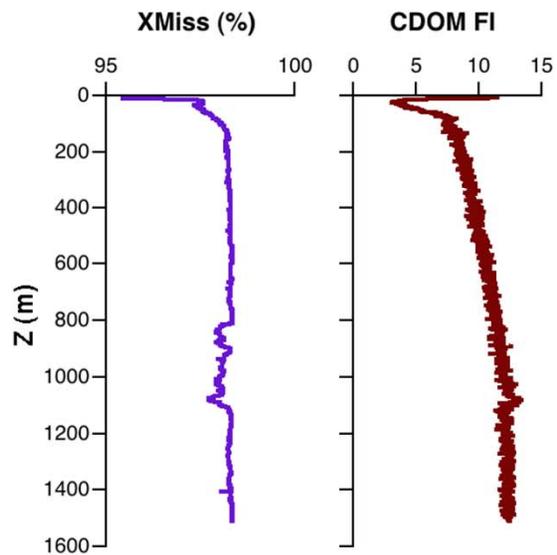
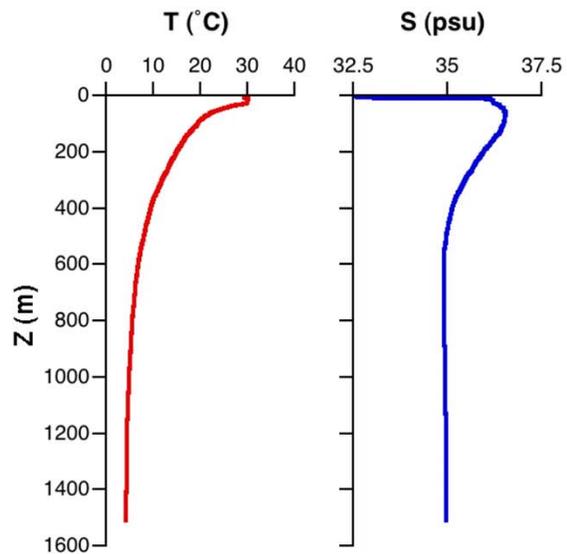
Stn 002

96 nm SE of DWH



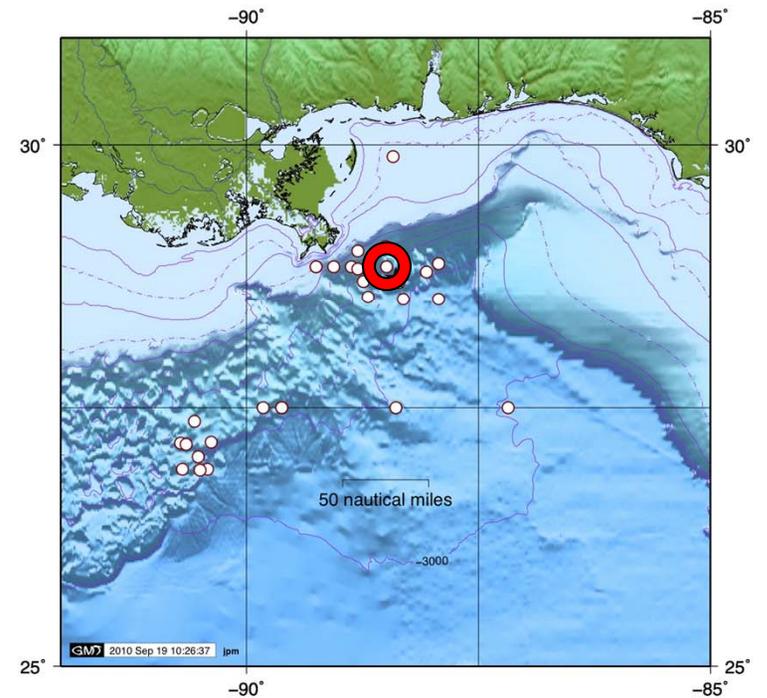
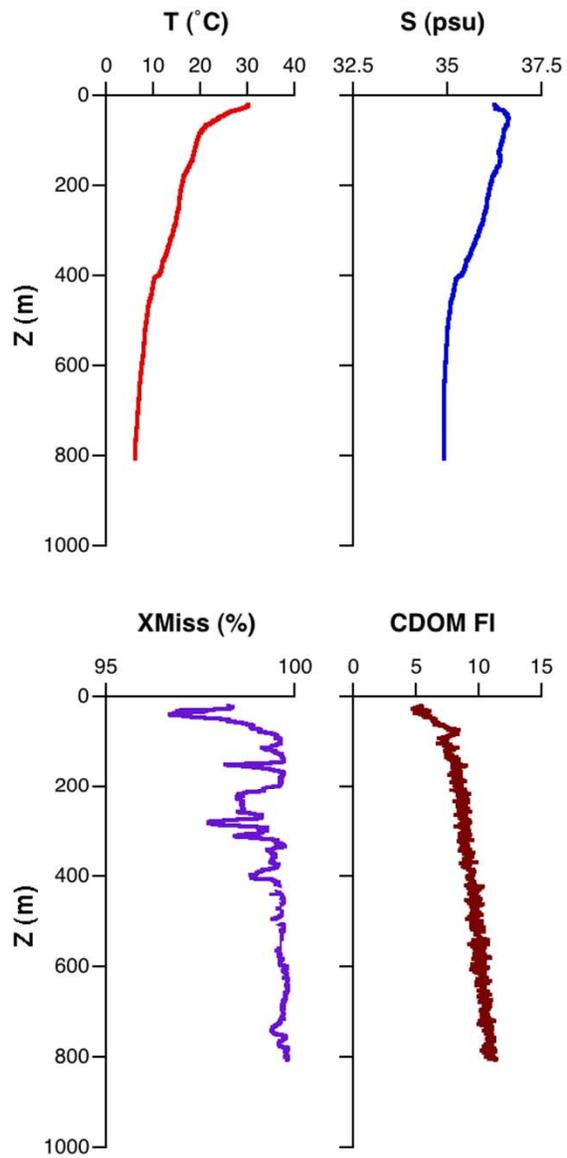
Stn 006

103 nm SW of DWH



Stn 017

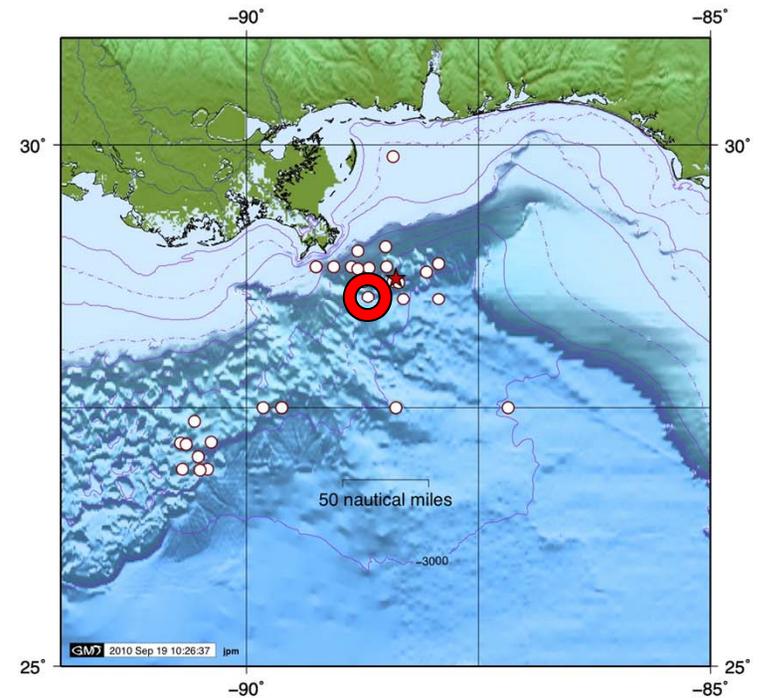
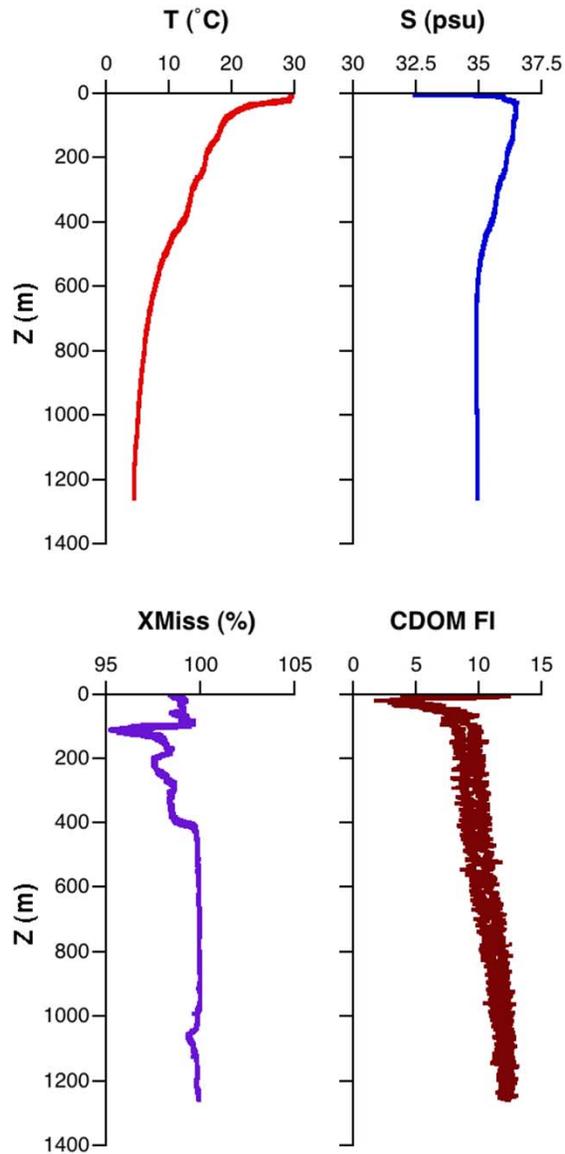
10 nm NW of DWH



Stn 025

19 nm SW of DWH

What's this about?



What about Zooplankton?



Discolored Zooplankton

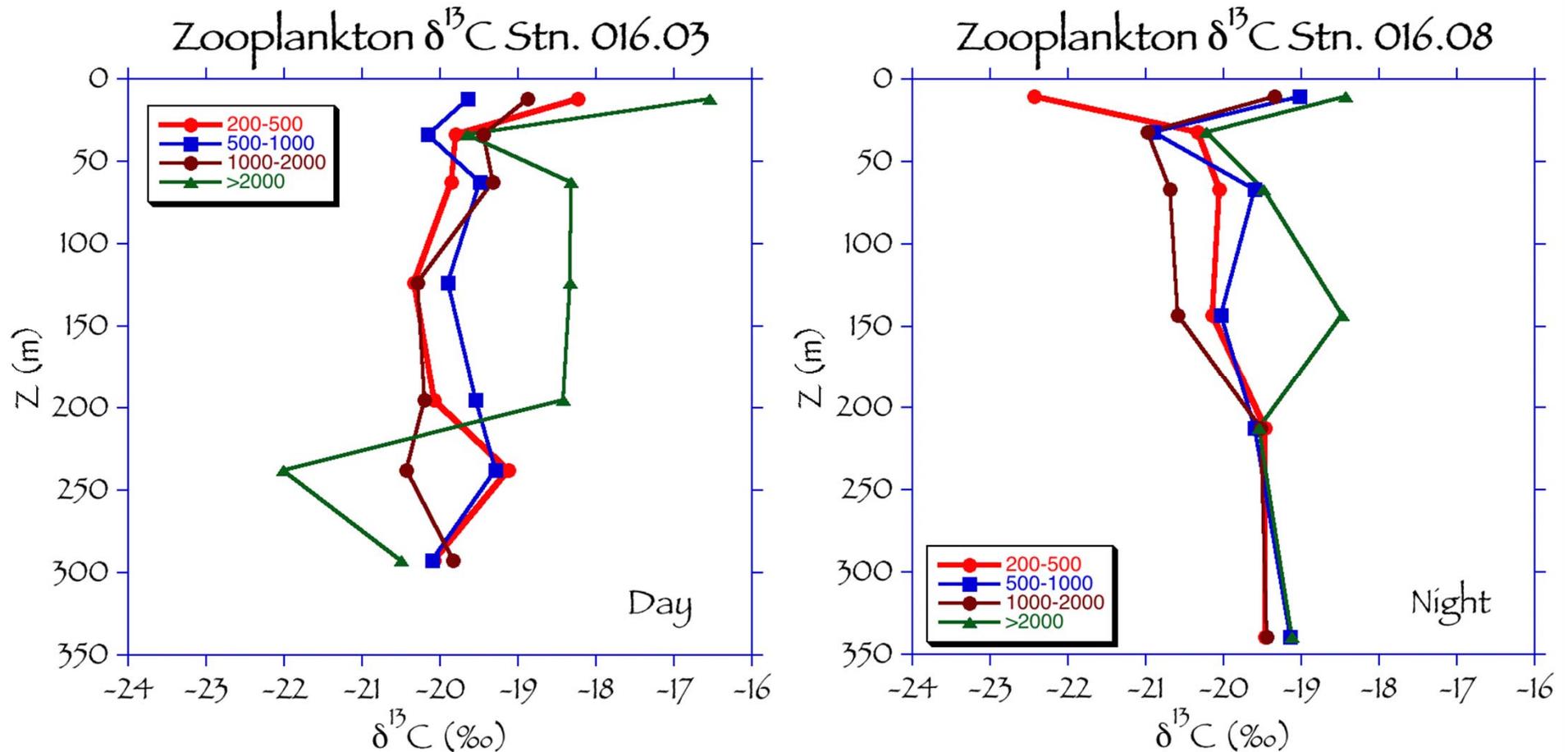


- Surf - 24 m
Note dark coloration



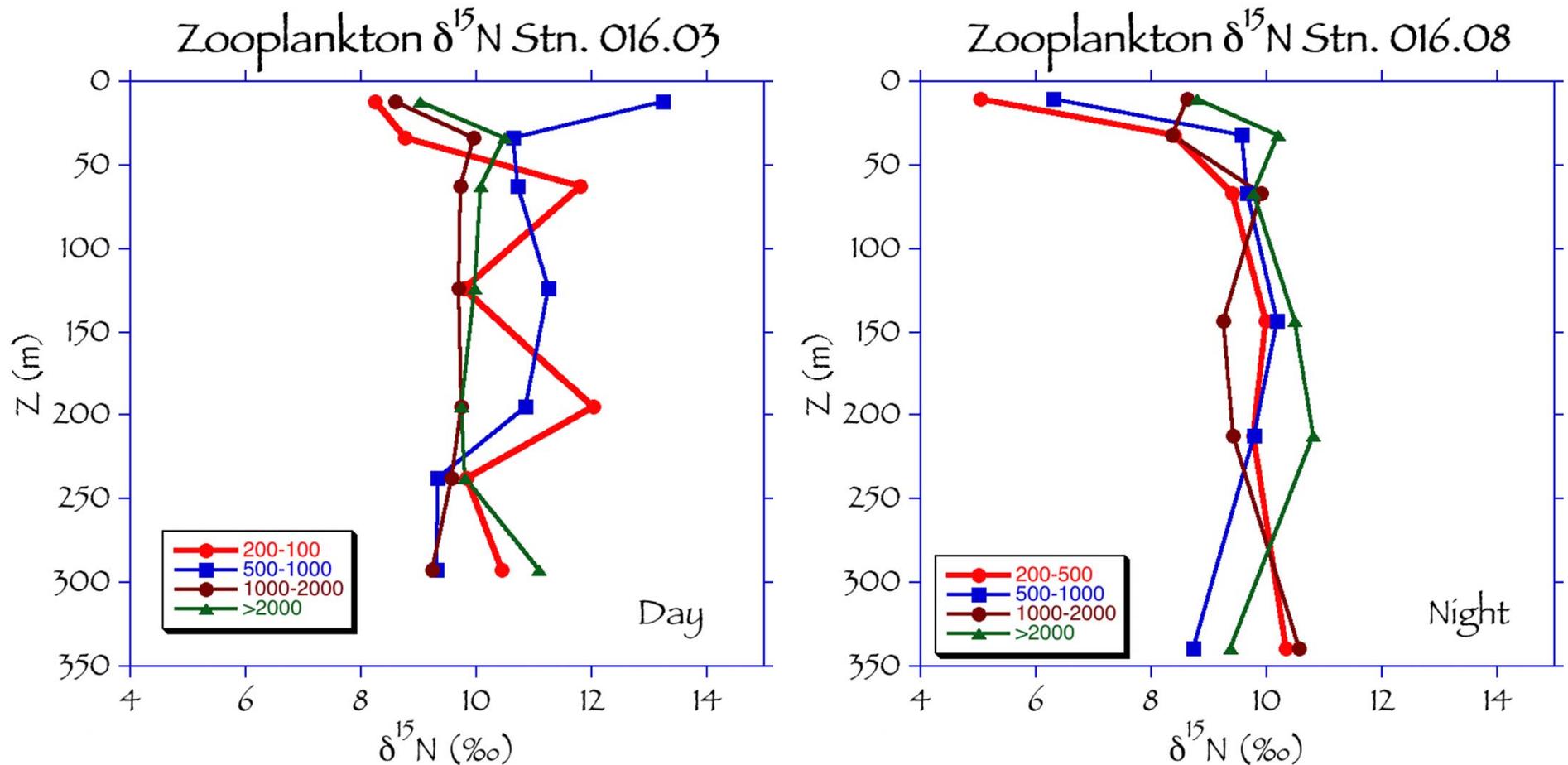
- 24 - 44 m
normal coloration

Stn 016 Zooplankton $\delta^{13}\text{C}$



17 nm NE of the DWH wellhead

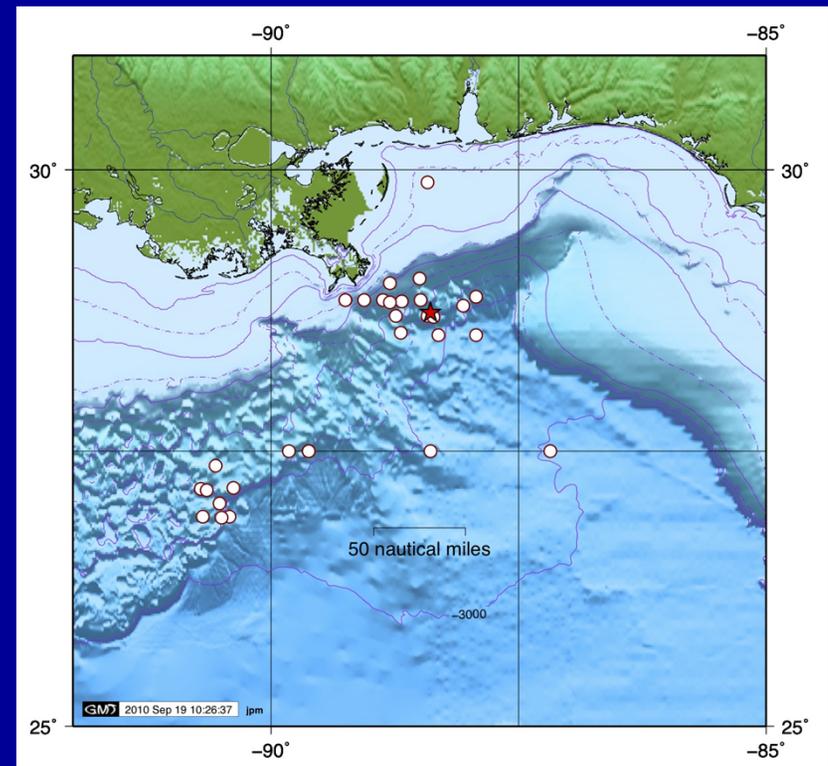
Stn 016 Zooplankton $\delta^{15}\text{N}$



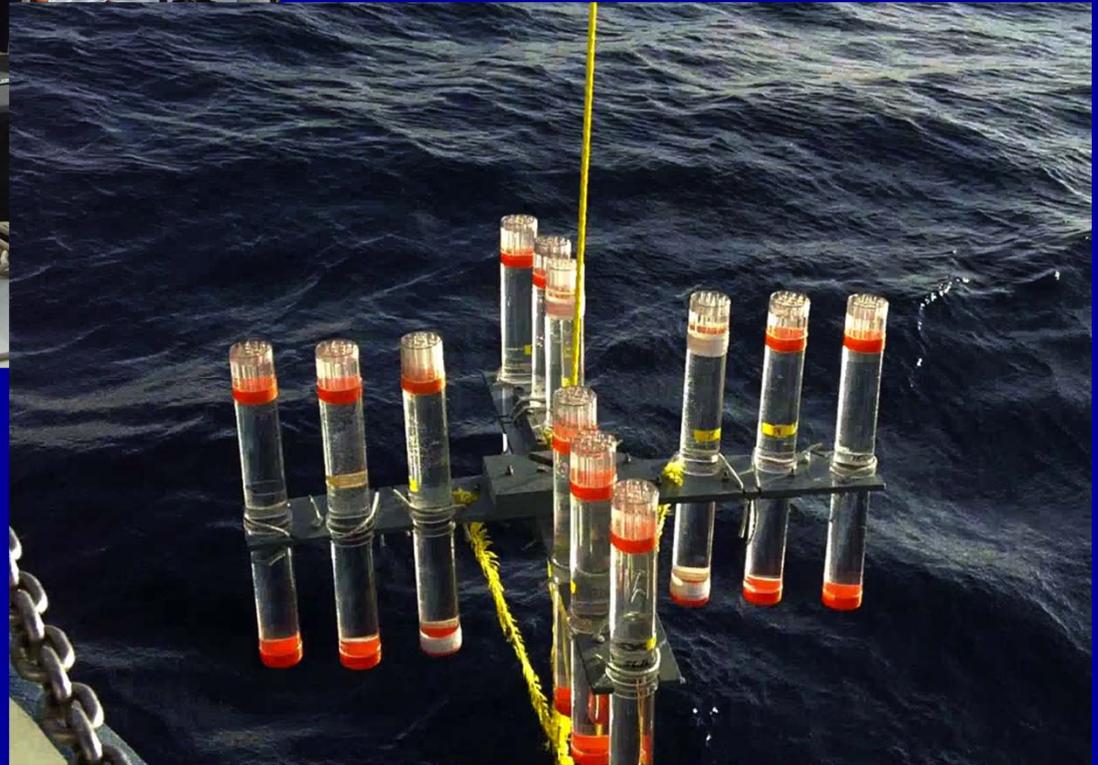
17 nm NE of the DWH wellhead

So what ...

- PC and PN not consistently elevated in turbid layers.
- Some turbid layers tend toward lower $\delta^{13}\text{C}$, others toward higher $\delta^{13}\text{C}$.
- Small surface zooplankton show clear diel shifts in $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ that are consistent with inputs of oil-derived C into the food web.

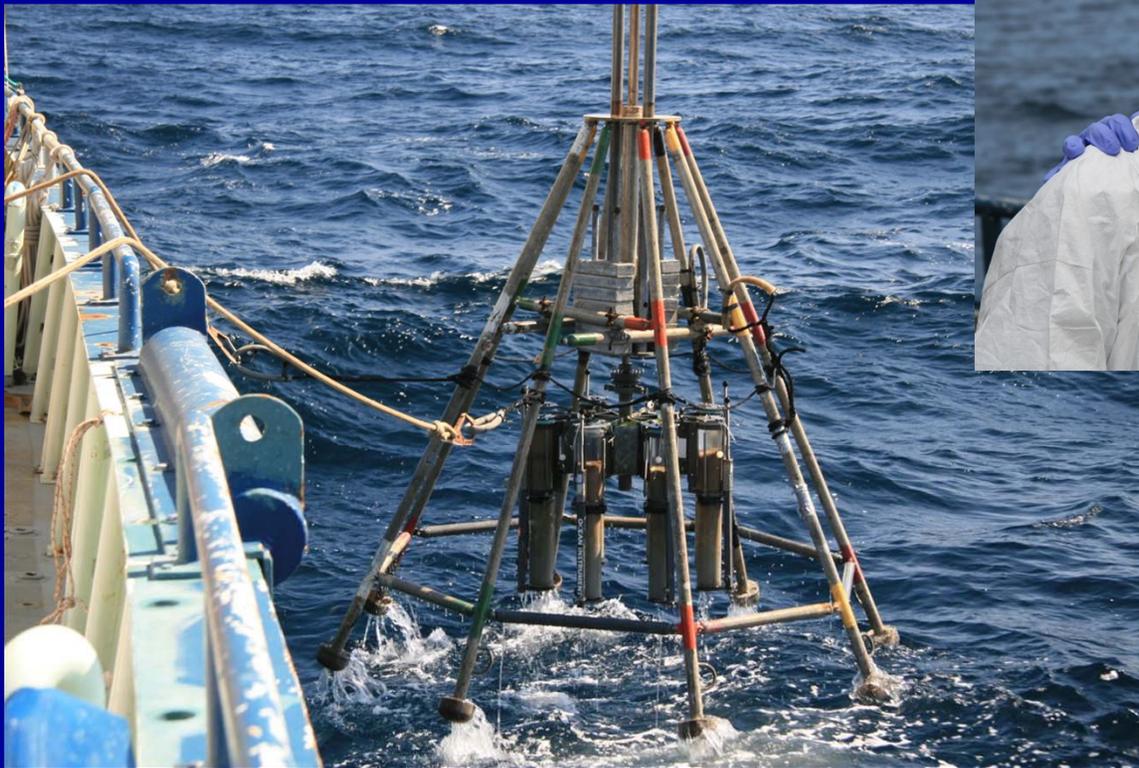


What Else? Sediment Traps...



- Timeseries trap
- Floating trap

...and a Multicorer



... and another cruise!

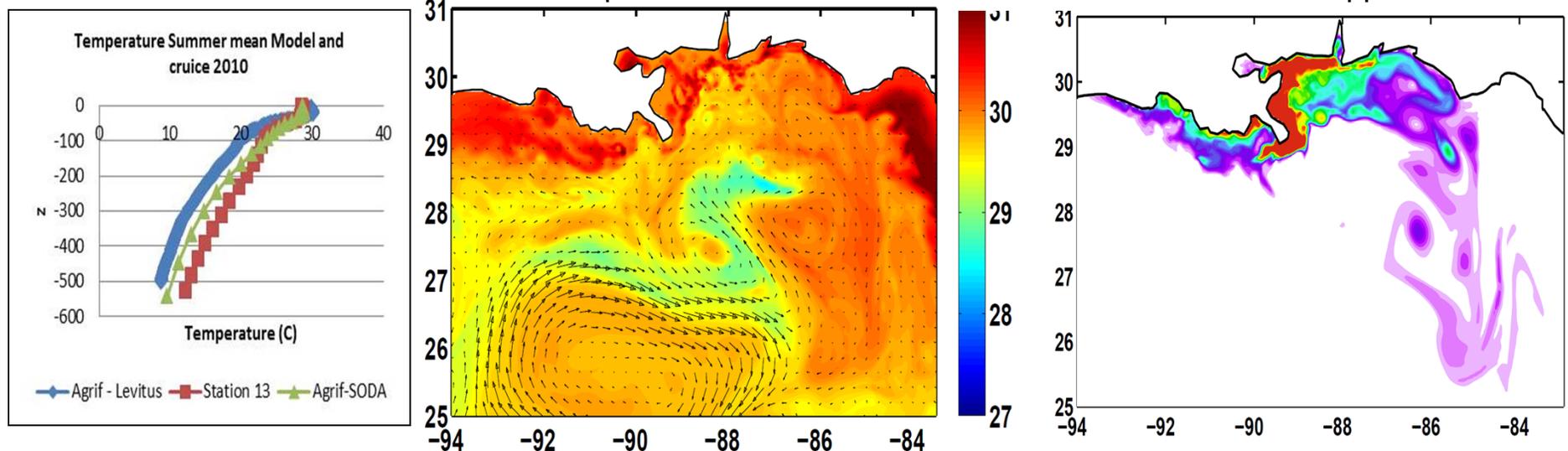
- EN496: 2 - 27 July 2011
- Similar sampling effort in a year with extremely high runoff from the Mississippi.



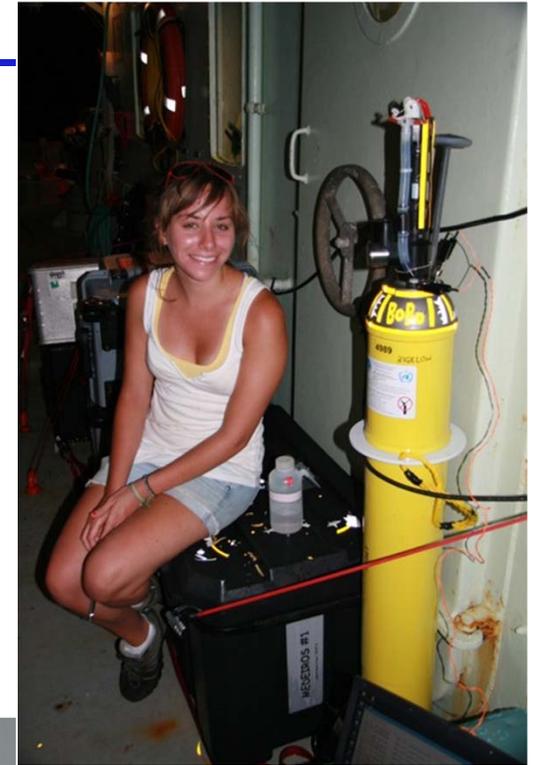
Annalisa Bracco, EAS, Gatech

- Modeling of transport pathways using ROMS, Regional Ocean Modeling System (process oriented studies).
- Focus on meso- and submeso-scales. 2km horizontal resolution over the basin; 500m in nested areas; 50-60 vertical layers
- Direct and inverse (adjoint) calculations to identify source waters and mixing dynamics around seeps
- Passive and active (biological/chemical) tracers

Model validation with cruise data Model temp and vel for 08/2000 with tracers released at Mississippi delta



Thanks for Listening!



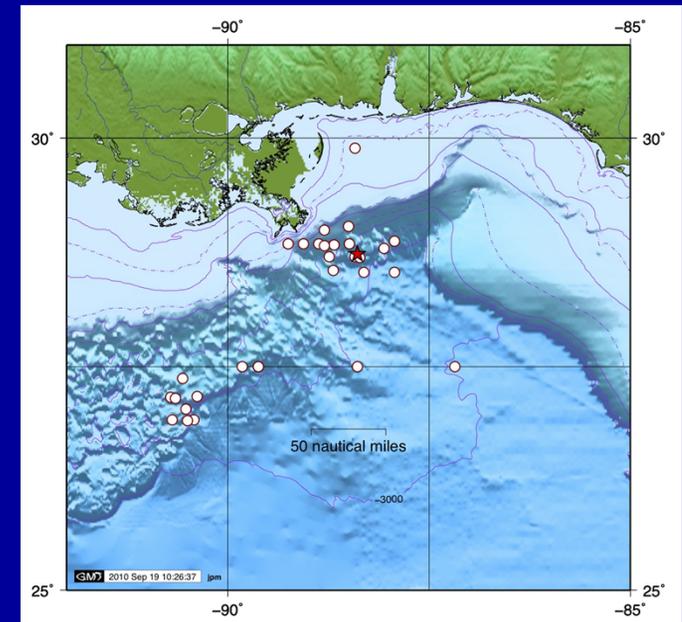
Georgia Tech Biological Oceanography

Multicorer



Core Top Layer

- Flocculent layer found at all stations within ca. 25 nautical miles of the wellhead.
- Recent depositional event
 - pteropod and foram shells
 - dead macrofauna
- Oil-like features
 - + organoleptic tests
 - PAHs present
 - Globules resembling degraded oil



Bottom Line Findings

- Unusual features
 - Turbid layers in the water column
 - Flocculent layer on the sediment surface
- Ongoing analyses
 - microbial diversity and activity
 - hydrocarbon fingerprinting
 - elemental and isotopic composition
- Synthesis
 - physical-biological modeling