http://www.treehugger.com/corporate-responsibility/the-7-stupidest-statements-made-about-the-bp-gulf-oil-spill.html

UNIVERSITY OF THE PACIFIC
ECOLOGICAL ENGINEERING
RESEARCH PROGRAM

Gulf of Mexico Oil Spill- Hydrocarbon Distribution in Water and Sediment Samples

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Objectives

- Use all available monitoring data to determine the 3 dimensional distribution of hydrocarbons in subsurface waters surrounding the blowout site
- Compare monitoring data to model predictions
  - Determine if multiple plume occurred as predicted by Socolfsky et al., 2011
- Determine if and when toxic hydrocarbons occurred

Introduction-Timeline

- Data used in this study May 9th-June 28th, 2010
- April 20th: BP oil rig explodes in the GOM
- April 22nd: Oil rig sinks, 11 workers are missing
- April 25th: Blowout preventer fails
- April 28th: Coast Guard realizes the spill may take months to contain
- May 9th: The first research vessels start collecting data
- June 3th: Top Hat #4 begins collecting oil and gas from the leaking wellhead
- July 15th: Blowout is entirely contained

Introduction-Subsurface Plumes

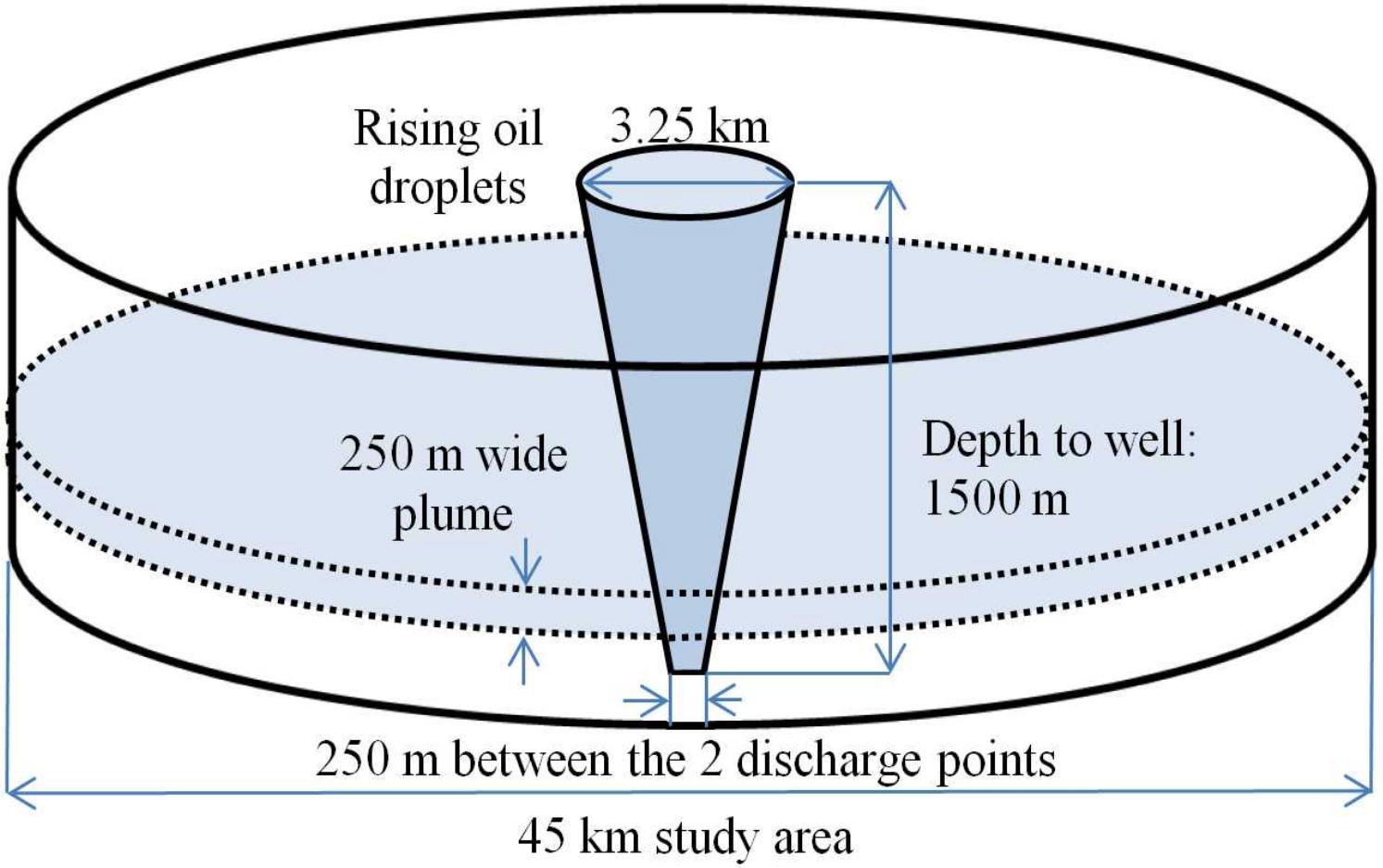


Figure adapted from Ryerson et al. 2011 and Socolfsky et al., 2011

Methods

- Compiled a complete set of all available deepwater hydrocarbon data collected as part of the Natural Resource Defense Assessment
- Data included
  - 16 research missions
  - 8 weeks of data
  - Over 150 hydrocarbon compounds
  - 45 km radius of the blowout
- Data analysis
  - Total hydrocarbon concentration per sample
  - Fraction of detectable results

Results-Sample collection

- On average each sample was measured for 70 different hydrocarbons with a standard deviation of 62
- More samples were collected in the southwest direction and at depths of 1,100-1,300 m probably as the result of plume chasing

Completeness of the data set	Samples were collected on average every:	Intervals for minimum	Minimum Samples per Interval	Minimum Results per Interval
Depth	2.5 m	100 m	34	2,184
Direction	150 m	45°	99	6,787
Distance	0.85°	5 km	12	946

Study Area

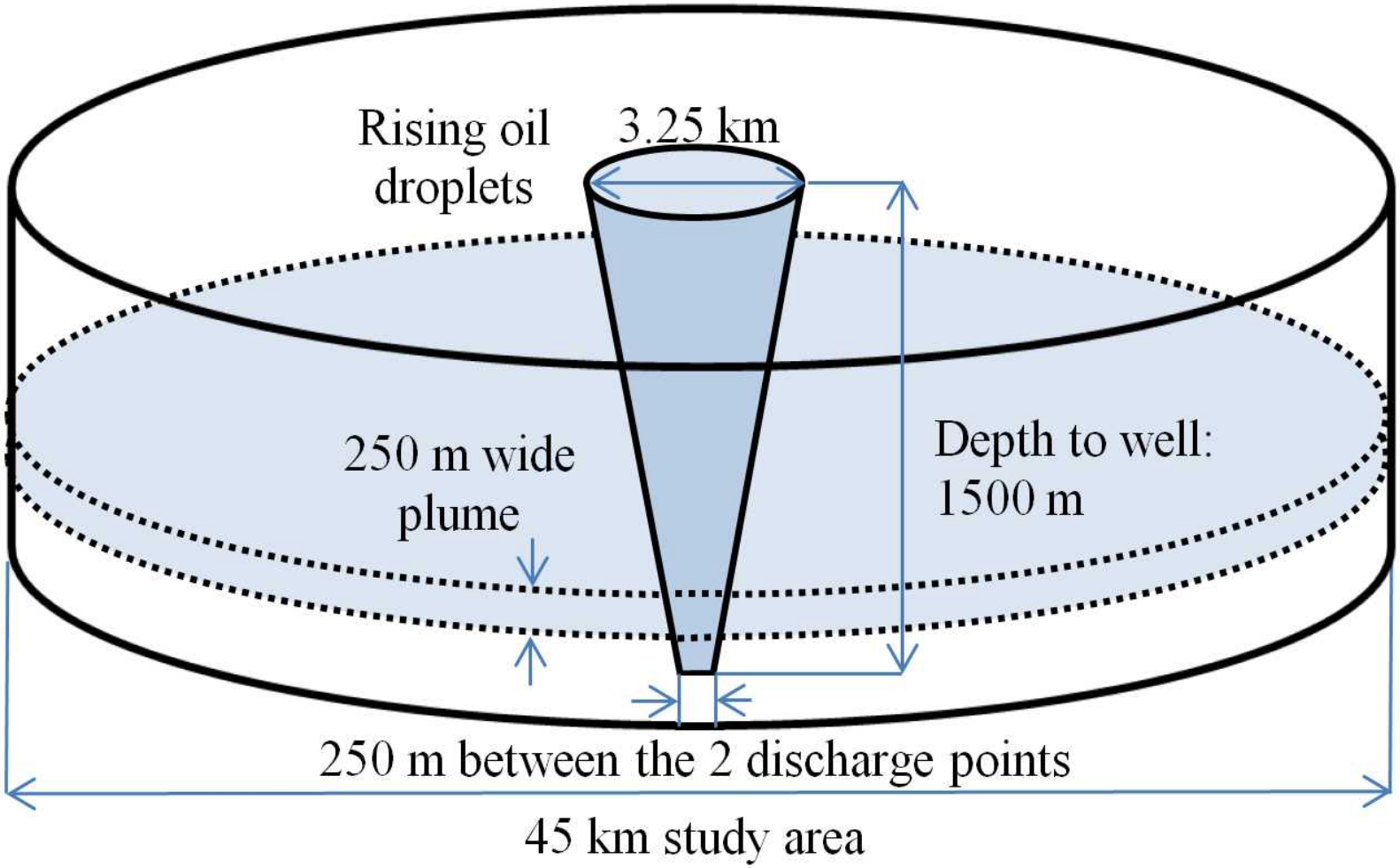


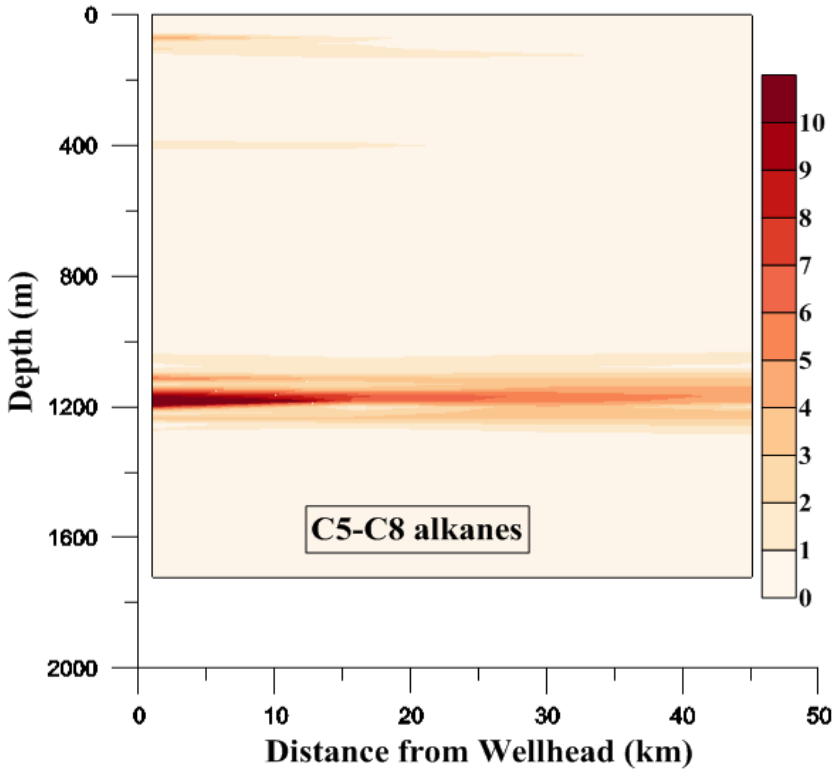
Figure adapted from Ryerson et al. 2011 and Socolfsky et al., 2011

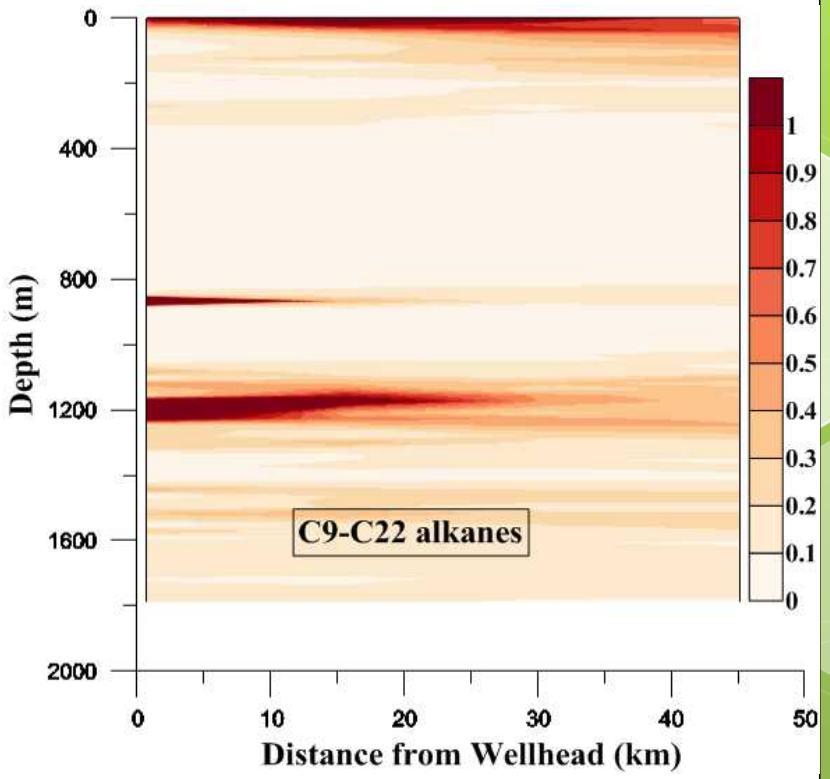
Results-Wider distribution then previously reported

	Rising cone of oil droplets and the deepwater plume (blue in study area)	All other sampling locations within a 45km radius of the wellhead (white study area)
Size of study area (km^3)	2,033	7,536
% of study area	21.2%	78.8%
Average Sample Concentration (µg/L)	**59.4**	**9.51**
% of detectable results	**22.6%**	**11.0%**
% of Benzene results above 10 ug/L	23.9%	0.1%
% of Benzene results above 1 ug/L	**40.9%**	**3.9%**
n samples	492	1475
n results	38,250	99,990

Results-Additional Plumes

- Inverse distance algorithm based contour plots



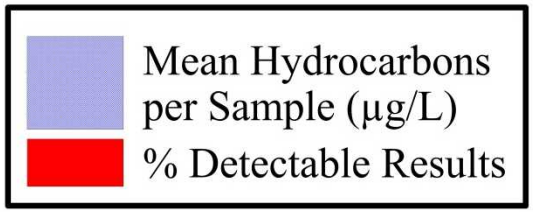


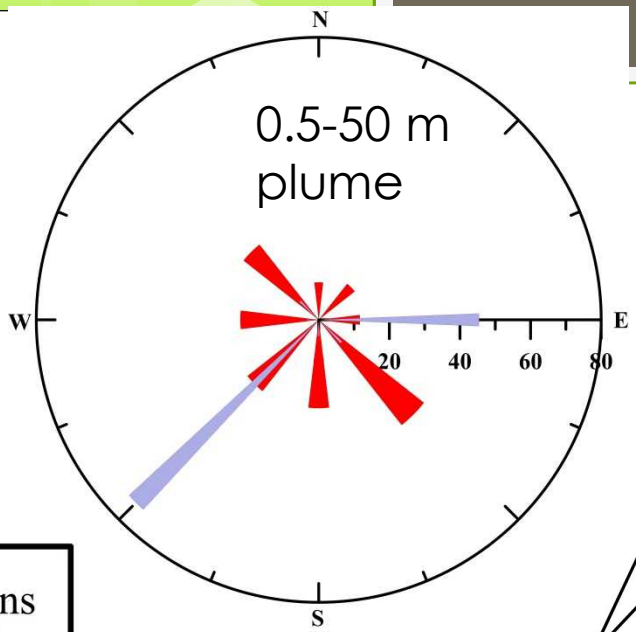
Results-Additional Plumes

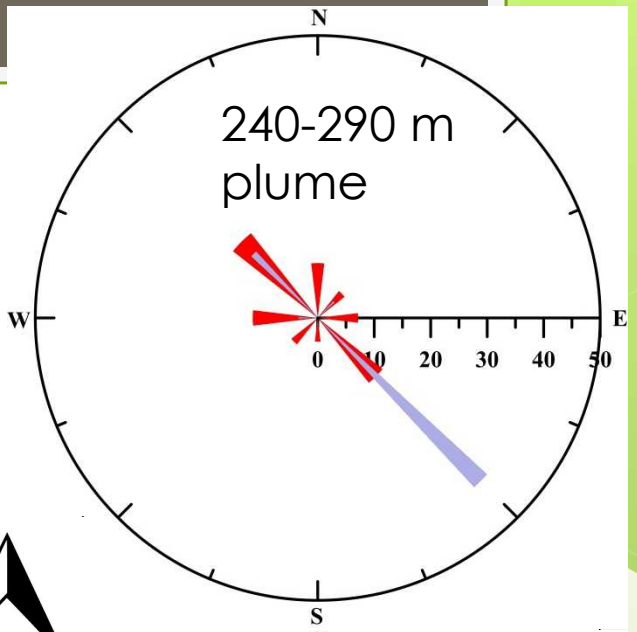
Depth (m)		Average sample concentration (µg/L)	% detectable results	Average number of results per sample	# of samples	Samples per m of depth
0.5-50	Plume-1	**27.2**	**22.6%**	62.1	333	6.7
50.1-100	Control-1	**7.6**	**8.0%**	77.6	94	1.9
240.1-290	Plume-2	**9.7**	**11.5%**	81.1	41	0.8
190-240 & 290.1-340.1	Control-2	**2.2**	**6.7%**	59.9	119	1.2
850-880	Plume-3	**10.6***	**18.2%**	43.3	29	1.0
819-849 & 881-911	Control-3	**2.8***	**11.7%**	68.4	56	0.9
1,050-1,300	Plume-4	**65.8**	**22.4%**	79.8	440	1.8
881-1,049 & 1,301-1,600	Control-4	**3.8**	**9.0%**	69.9	542	1.2

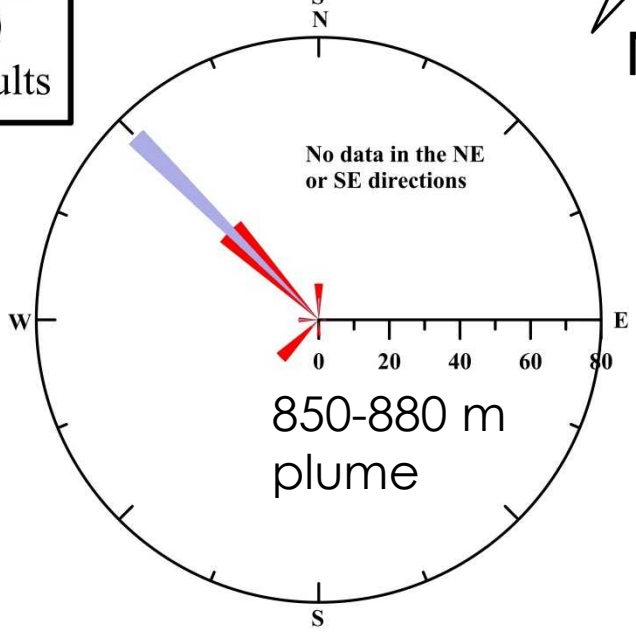
* Not significant at alpha=0.01

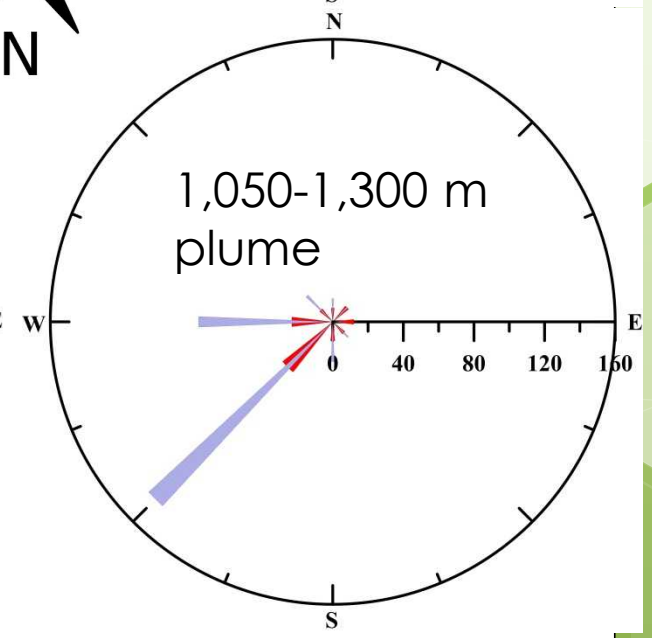
Distribution by compass direction



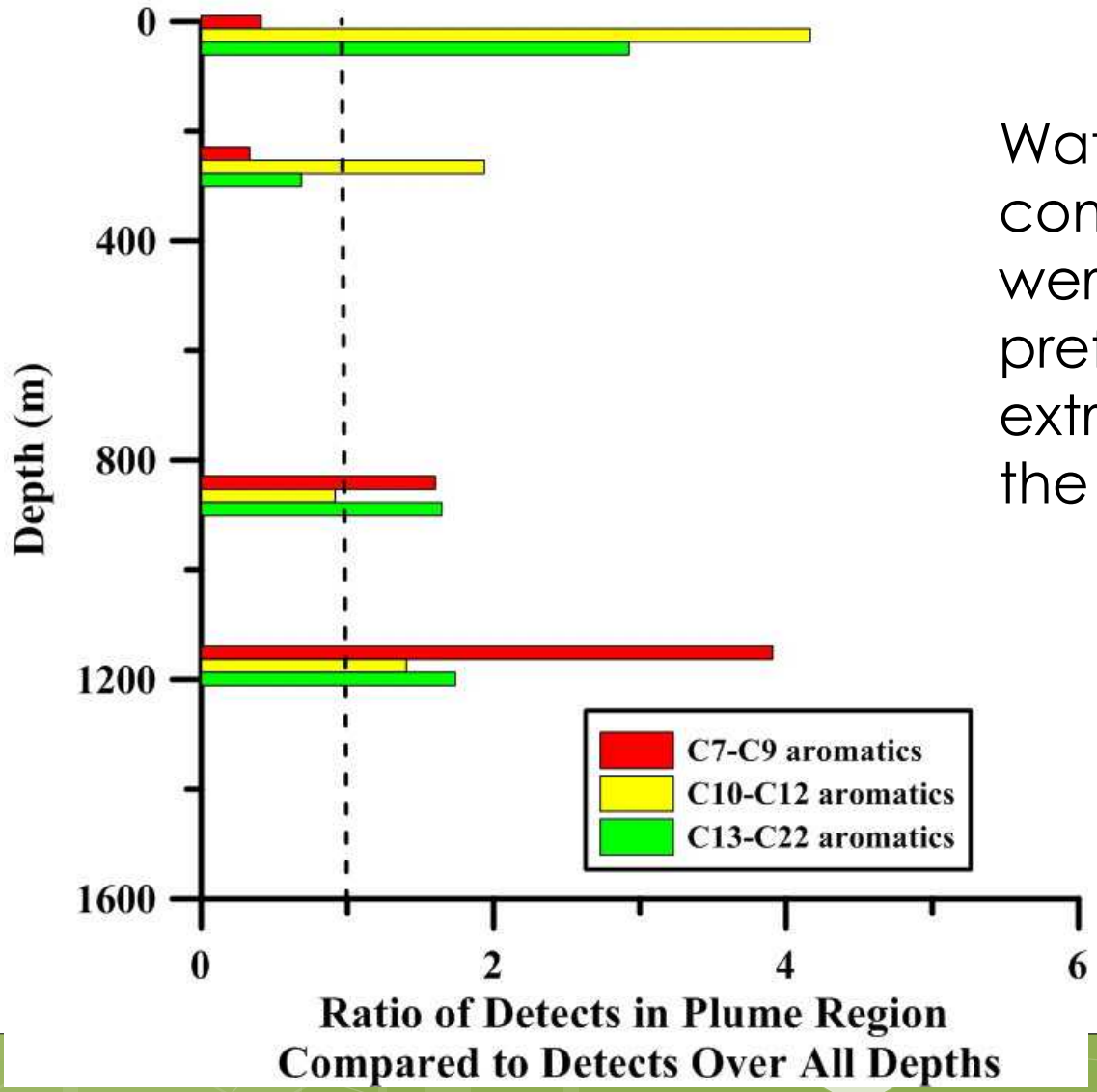






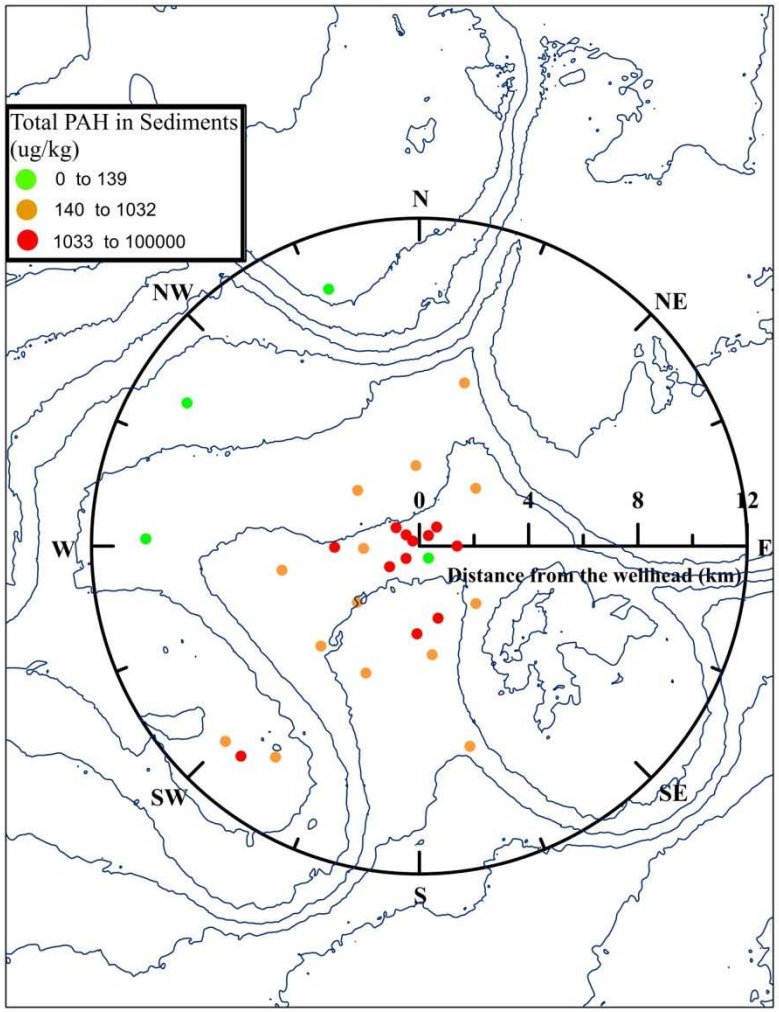


Results



Water soluble compounds were preferentially extracted in the deepwater

Conclusions-Distribution of PAHs in Sediments



- All samples with concentrations higher than the maximum PAHs found in a 2009 survey of the deep Gulf of Mexico were within 12 km of the blowout
- All samples above chronic toxicity limits were found within 3.2 km of the blowout
- No significant correlation was found between the distribution of hydrocarbons in the water column and sediments

Conclusions

- The data set is sufficient
- 1,050-1,300 m plume was verified
- Hydrocarbon distribution was more widely spread than previously predicted or reported
  - Additional plumes at 240 and 850 m were found
  - More systematic sampling plan would improve data analysis
- More soluble compounds were preferentially extracted in the deepwater
- Percentage of detectable results in addition to sample concentration is a useful data analysis technique

Acknowledgments

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