Toxic Tragedies: The Deepwater Horizon Disaster

Andrew Whitehead

Professor, Department of Environmental Toxicology, UC Davis

whiteheadresearch.wordpress.com @whitehead_ja

UC DAVIS
UNIVERSITY OF CALIFORNIA

The New Orleans Levee
" We don't hold anything back "

DISASTER September 10, 2011

Disaster recovery industry key to Louisiana's future

Marsh fires, oil disaster, chemical dumping, tropical cyclones and industrial accidents have made southern Louisiana the epicenter of the internation disaster industry. Gov. Bobby Jindal predicts disaster response and disaster recovery jobs will make up 40 percent of the state economy by 2015, with even higher gains possible if the state can "somehow break into the earthquake market."

SIX YEARS AFTER THE FEDERAL LEVEE BREAKS,

STATE FINDS ITSELF EMBRACING CALAMITY


April 20, 2010


WUWT
22 14:50



WUWT
22 14:51

What happened?

How did it happen?

What are the **consequences**?

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The Technology

Deepwater Horizon oil rig

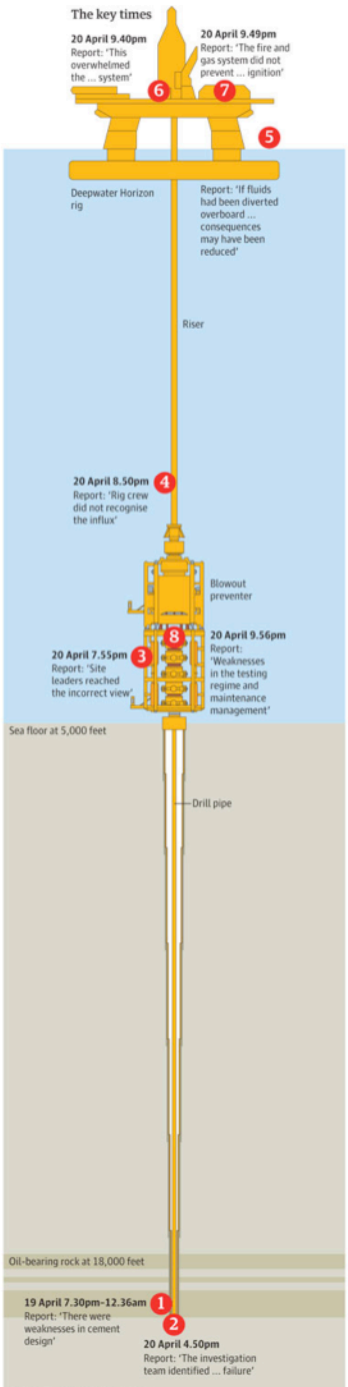
→ Built in 2001 by Hyundai Heavy Industries, South Korea

→ At the time, one of the most complex machines ever made

→ Commissioned by R&B Falcon (later part of Transocean)

→ Leased to BP

→ In 2009 drilled the deepest well in history



The Technology

Dynamically-positioned

Located far offshore → BOP not directly accessible

Riser → conduit for drilling mud circulation and drill assembly, direct path from BOP to the rig

Crew rotation

Wellhead far below the surface

Multiple companies (Cementing, Mud, Drilling, Oil, etc…)

ROV → remote-controlled robot for any and all tasks performed on the sea floor

VERY expensive ($600k per day)

Series of Issues

Casing design

Cement design

Negative pressure test

Flow monitoring

Ignition

Blowout preventer

4 Key Events

1. The cement job failed

4 Key Events

1. The cement job failed
2. Hydrocarbons inflow was not recognized

→ Two negative pressure tests were conducted, and incorrectly deemed successful by the crew
→ No SOP for negative pressure tests

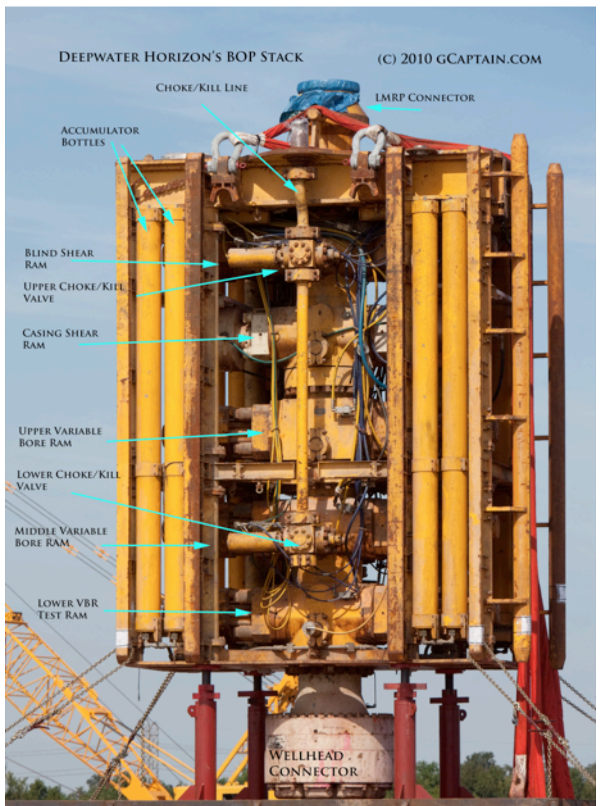
4 Key Events

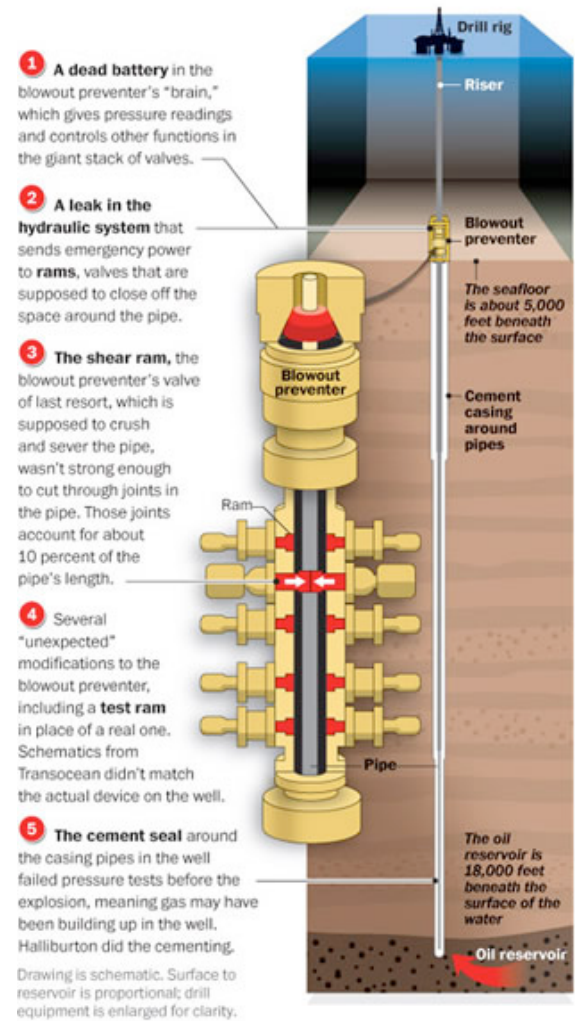
1. The cement job failed
2. Hydrocarbons inflow was not recognized
3. Explosion on the rig causing loss of power

"A flammable mixture was likely transferred into the engine rooms because the engine room HVAC fans were not designed to shut down automatically on gas detection." "There was a high level of reliance upon manual/human intervention in the activation of DH safety systems..."

4 Key Events

1. The cement job failed
2. Hydrocarbons inflow was not recognized
3. Explosion on the rig causing loss of power
4. Blowout preventer failed
   - Manual
   - Automatic
   - ROV





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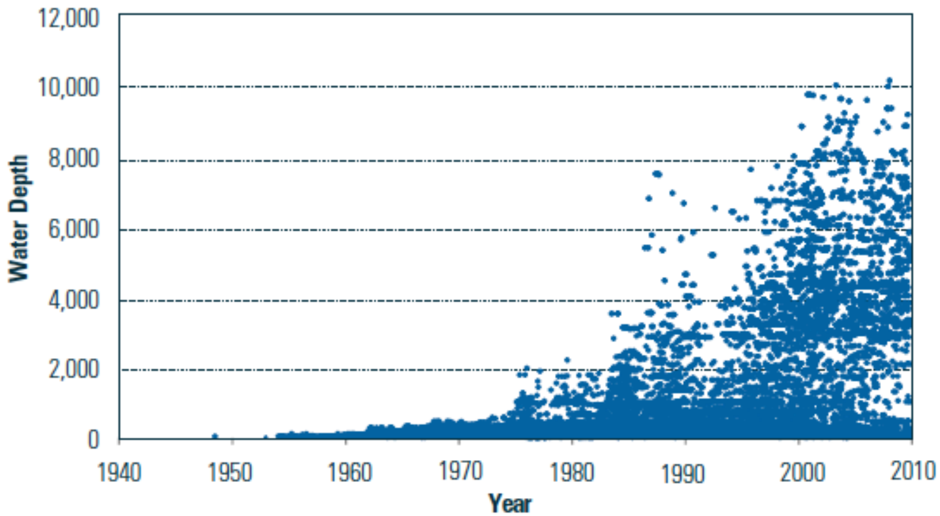
History of Offshore Oil and Gas in the United States

1896	First offshore oil production in the United States—from wooden piers off Summerland, California
1938	First Gulf of Mexico discovery well in state waters; first free-standing production platform in the ocean—Creole field offshore Louisiana
1947	First well drilled from fixed platform offshore out-of-sight-of-land in Federal waters —Kermac 16 offshore Louisiana
1953	Submerged Lands Act & Outer Continental Shelf Lands Act
1954	First federal Outer Continental Shelf lease sale & Maiden voyage of the *Mr. Charlie* submersible drilling vessel, industry's first "day rate" contract
1962	First semi-submersible drilling vessel, *Blue Water 1*, and first subsea well completion
1969	Santa Barbara blowout/oil spill (California)
1978	Shell Oil Company's Cognac production platform (first in 1,000 feet of water) & OCS Lands Act Amendments
1981	First Congressional Outer Continental Shelf leasing moratorium
1982	Creation of the Minerals Management Service (MMS)
1988	Piper Alpha disaster in the North Sea
1994	First production from Shell's Auger tension-leg platform in 2,860 feet of water
1995	Deepwater Royalty Relief Act
1996	First spar production facility in the Gulf of Mexico at the Neptune field
1999	Discovery of BP's Thunder Horse field in 6,000 feet of water; at 1 billion barrels of oil equivalent, the largest discovery in the Gulf of Mexico
2006	Successful test at the Jack 2 field, in 7,000 feet of water and more than 20,000 feet below the seafloor, establishing the viability of the deepwater Lower Tertiary play
2010	Arrival of *Deepwater Horizon* at Macondo well in January

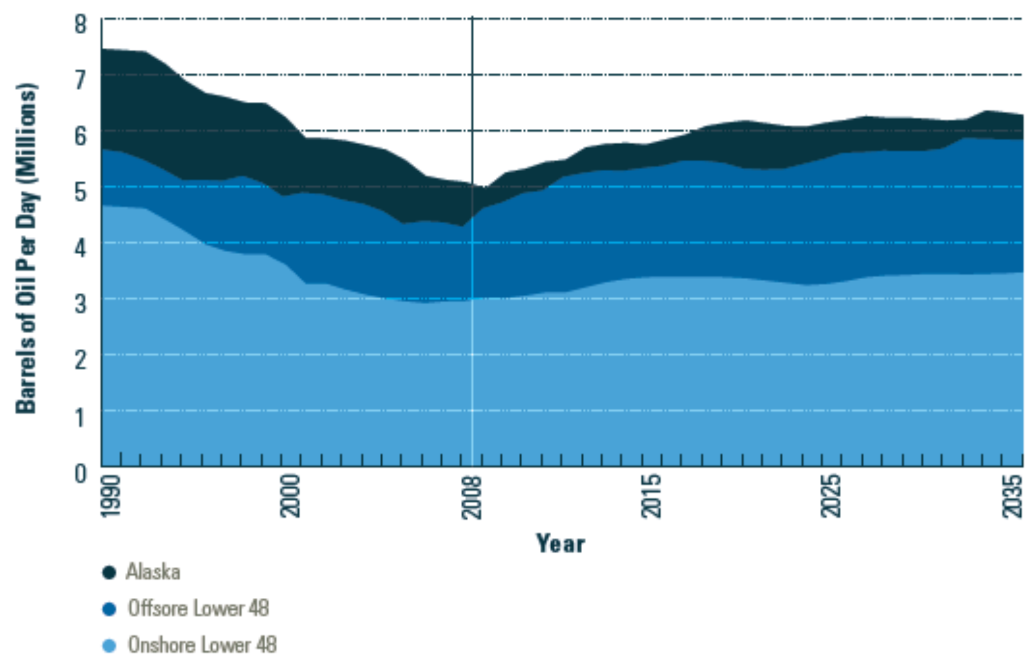
FIGURE 2.4: Wells Drilled in the Gulf of Mexico by Water Depth, 1940-2010



Source: Commission staff, adapted from Bureau of Ocean Energy Management, Regulation and Enforcement

Deep water is where the oil is at…

- → 30% of domestic production is from GOM
- → 80% of GOM is from deep water
- → SO… ¼ of domestic production is from deep water
- → Global deepwater production tripled since 2000
- → Much new oil is in deep water
- → Since 2000, 8,000 new wells in GOM, 2,000 of those in deep water



Source: Commission Staff, Adapted from U.S. Energy Information Administration

Minerals Management Service

MMS: Conflicting mandate: both regulate offshore energy leases and collect the revenue they generated

"At the time of the Macondo blowout—almost 20 years after its original proposal—MMS had still not published a rule mandating that all operators have plans to manage safety and environmental risks. The agency's efforts to adopt a more rigorous and effective risk-based safety regulatory regime were repeatedly revisited, refined, delayed, and blocked alternatively by industry or skeptical agency political appointees. MMS thus never achieved the reform of its regulatory oversight of drilling safety consonant with practices that most other countries had embraced decades earlier." "In the last twenty years, MMS's leasing, environmental, and regulatory budget decreased or remained static while deepwater oil production in the Gulf of Mexico boomed." – National Commission, Report to the President, 2011

FIGURE 3.3: MMS Budget and Gulf of Mexico Crude Oil Production, 1984-2009

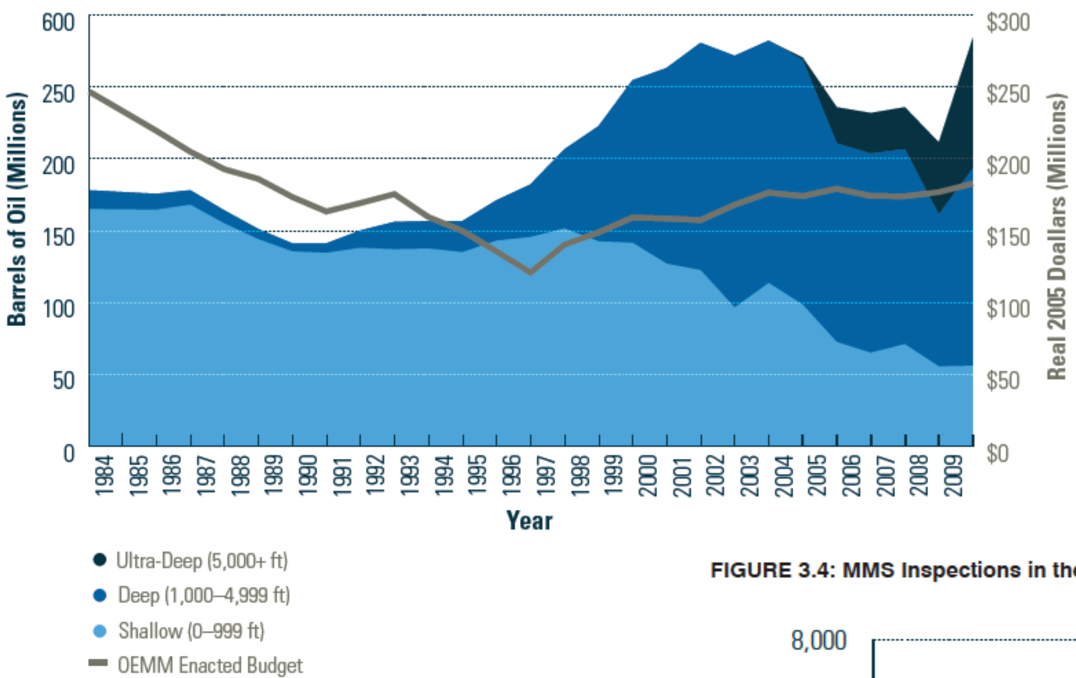
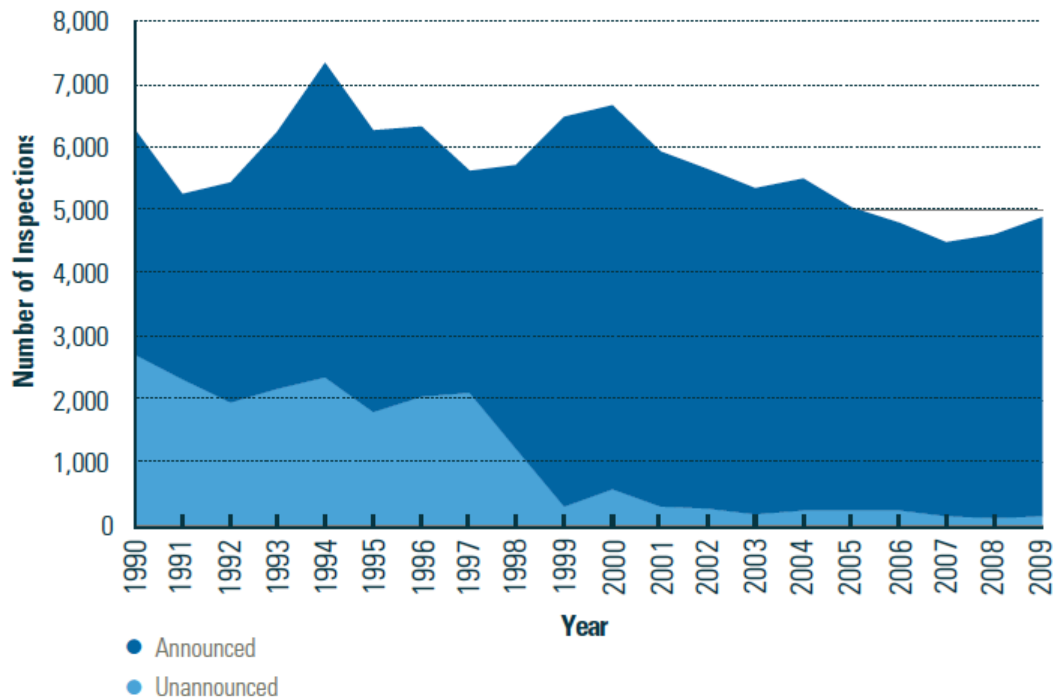


FIGURE 3.4: MMS Inspections in the Gulf of Mexico, 1990-2009



ROOT CAUSES: Failures in Industry and Government

Management Failures by Industry

1. BP's management process did not adequately identify or address risks created by late changes to well design and procedures

2. Halliburton and BP's management processes did not ensure that cement was adequately tested.

3. BP, Transocean, and Halliburton failed to communicate adequately. For example, many BP and Halliburton employees were aware of the difficulty of the primary cement job. But those issues were for the most part not communicated to the rig crew that conducted the negative-pressure test and monitored the well

4. Transocean failed to adequately communicate lessons from an earlier near-miss to its crew.

5. Decision making processes at Macondo did not adequately ensure that personnel fully considered the risks created by time-saving and money-saving decisions

FIGURE 4.10: Examples of Decisions That Increased Risk At Macondo While Potentially Saving Time

Decision	Was There A Less Risky Alternative Available?	Less Time Than Alternative?	Decision-maker
Not Waiting for More Centralizers of Preferred Design	Yes	Saved Time	BP on Shore
Not Waiting for Foam Stability Test Results and/or Redesigning Slurry	Yes	Saved Time	Halliburton (and Perhaps BP) on Shore
Not Running Cement Evaluation Log	Yes	Saved Time	BP on Shore
Using Spacer Made from Combined Lost Circulation Materials to Avoid Disposal Issues	Yes	Saved Time	BP on Shore
Displacing Mud from Riser Before Setting Surface Cement Plug	Yes	Unclear	BP on Shore
Setting Surface Cement Plug 3,000 Feet Below Mud Line in Seawater	Yes	Unclear	BP on Shore (Approved by MMS)
Not Installing Additional Physical Barriers During Temporary Abandonment Procedure	Yes	Saved Time	BP on Shore
Not Performing Further Well Integrity Diagnostics in Light of Troubling and Unexplained Negative Pressure Test Results	Yes	Saved Time	BP (and Perhaps Transocean) on Rig
Bypassing Pits and Conducting Other Simultaneous Operations During Displacement	Yes	Saved Time	Transocean (and Perhaps BP) on Rig

ROOT CAUSES: Failures in Industry and Government

Regulatory Failures

1. MMS regulations were inadequate to address the risks of deepwater drilling (e.g., there was no requirement or protocol for a negative pressure test → misreading of which was a major contributor to the blowout.)

2. Efforts to expand regulatory oversight, tighten safety requirement, provide funding for regulators to be effective, were either overtly resisted or not supported by industry, members of Congress, and several administrations

3. Even with adequate funding MMS lacked personnel with appropriate expertise and training needed to enforce regulations effectively

"Deepwater drilling provides the nation with essential supplies of oil and gas. At the same time, it is an inherently risky business given the enormous pressures and geologic uncertainties present in the formations where oil and gas are found—thousands of feet below the ocean floor. Notwithstanding those inherent risks, the accident of April 20 was avoidable. It resulted from clear mistakes made in the first instance by BP, Halliburton, and Transocean, and by government officials who, relying too much on industry's assertions of the safety of their operations, failed to create and apply a program of regulatory oversight that would have properly minimized the risks of deepwater drilling. It is now clear that both industry and government need to reassess and change business practices to minimize the risks of such drilling."

– National Commission, Report to the President, 2011

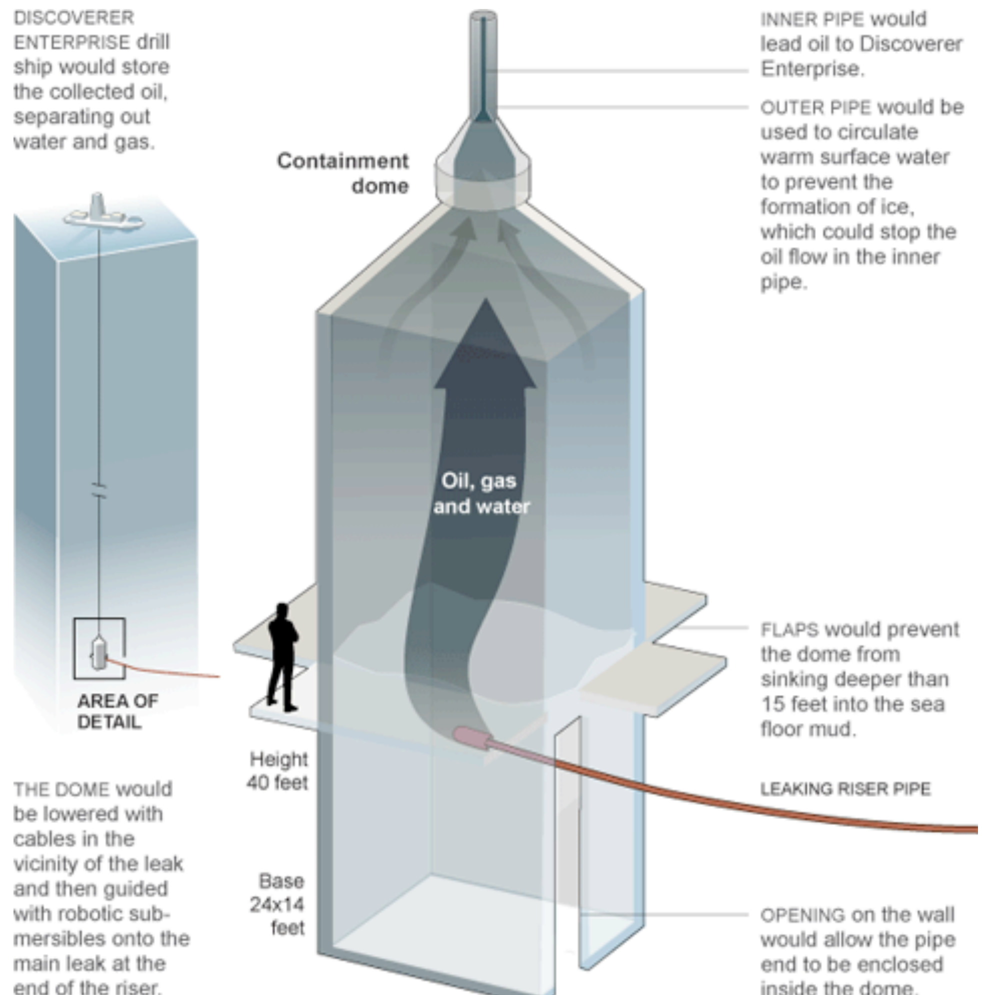
Flow rate estimates:

Initial BP estimates = 1,000 to 5,000 barrels per day
Really = 62,000 barrels per day = 2.6 million gallons per day

NO PLAN to fix a deepwater blowout that did not include a functioning BOP

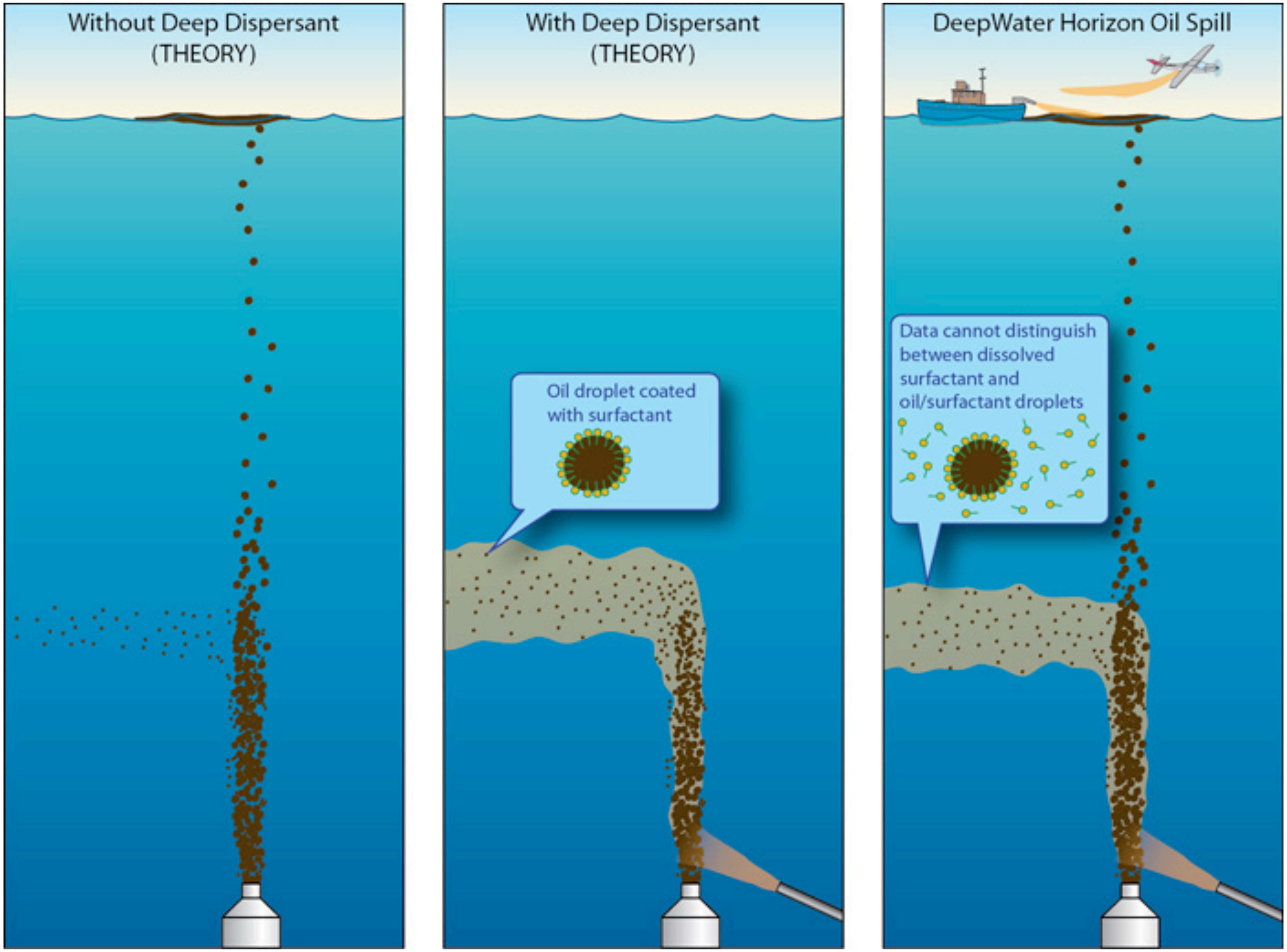
The fix…

1. Cofferdam



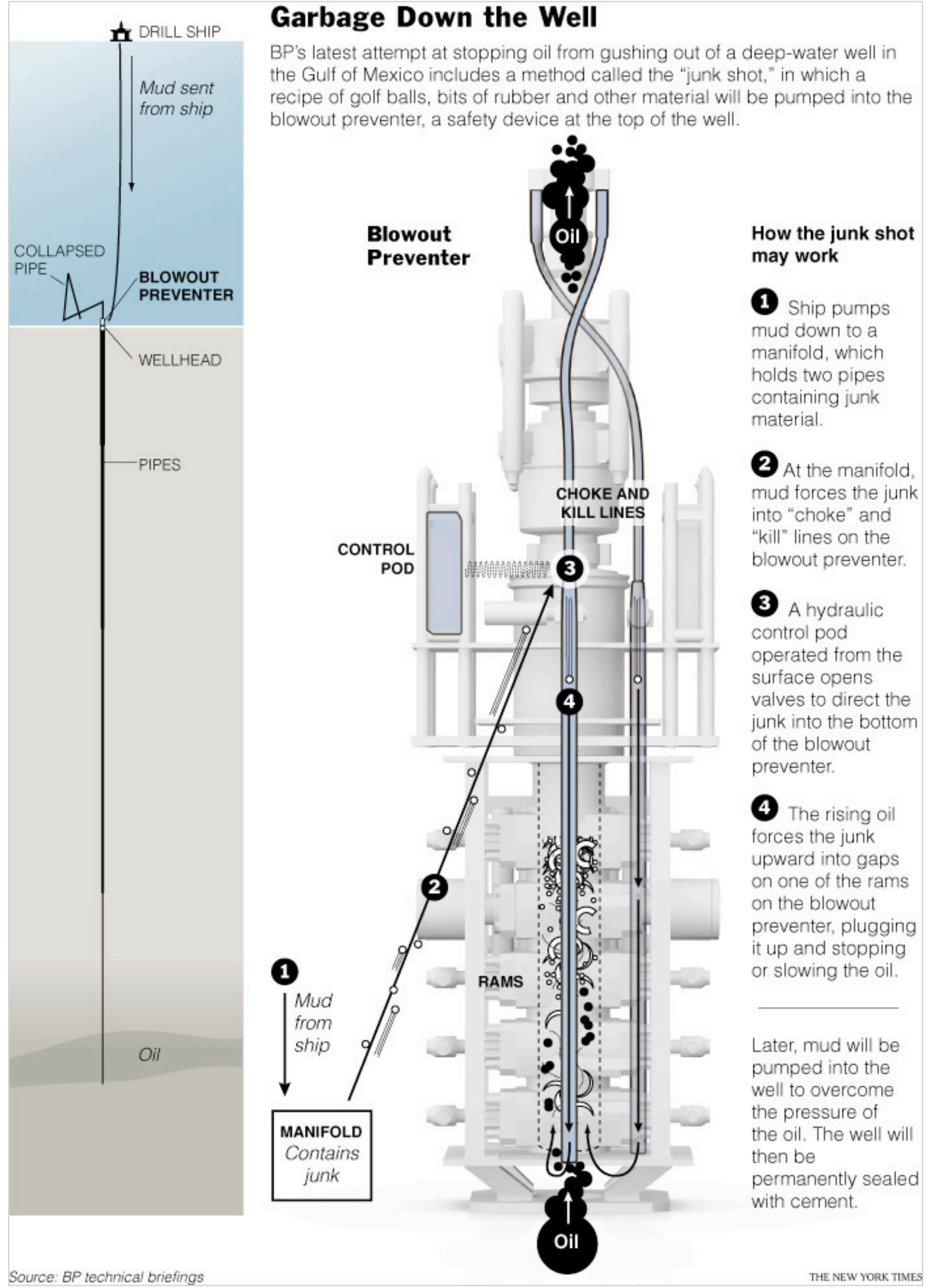
The fix…

1. Cofferdam
2. Dispersants



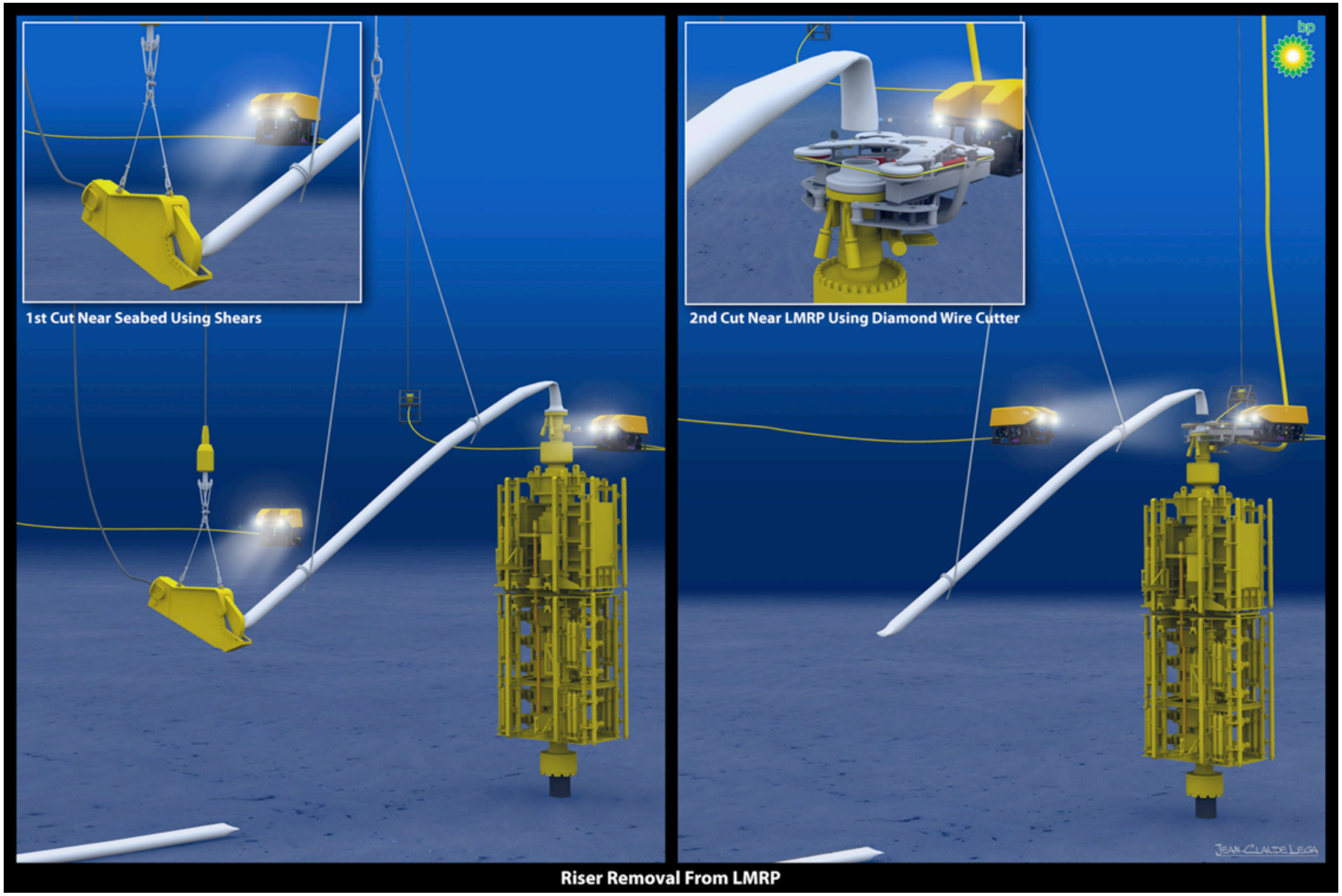
The fix…

1. Cofferdam
2. Dispersants
3. Junk shot



The fix…

1. Cofferdam
2. Dispersants
3. Junk shot
4. Top Hat



The fix…

1. Cofferdam
2. Dispersants
3. Junk shot
4. Top Hat
5. Capping stack

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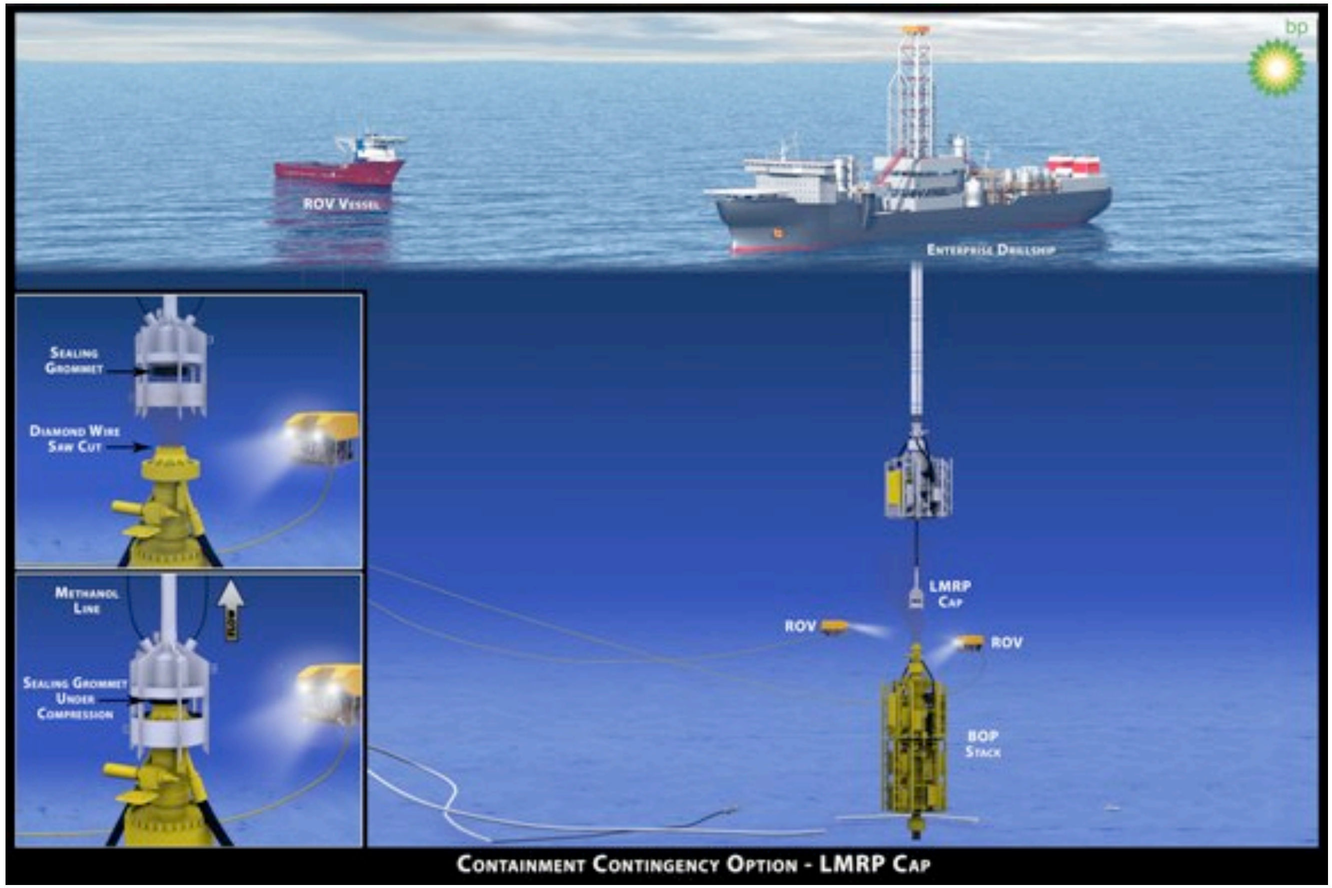
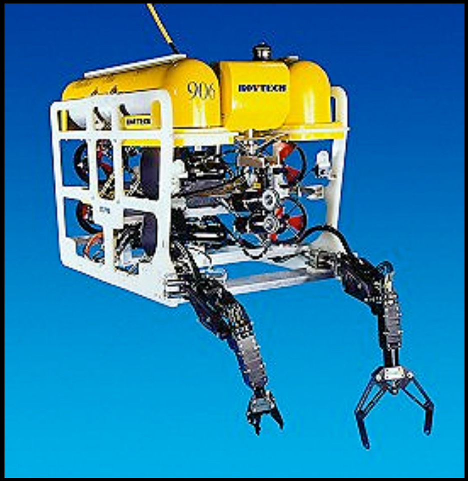


Compare the Technologies…



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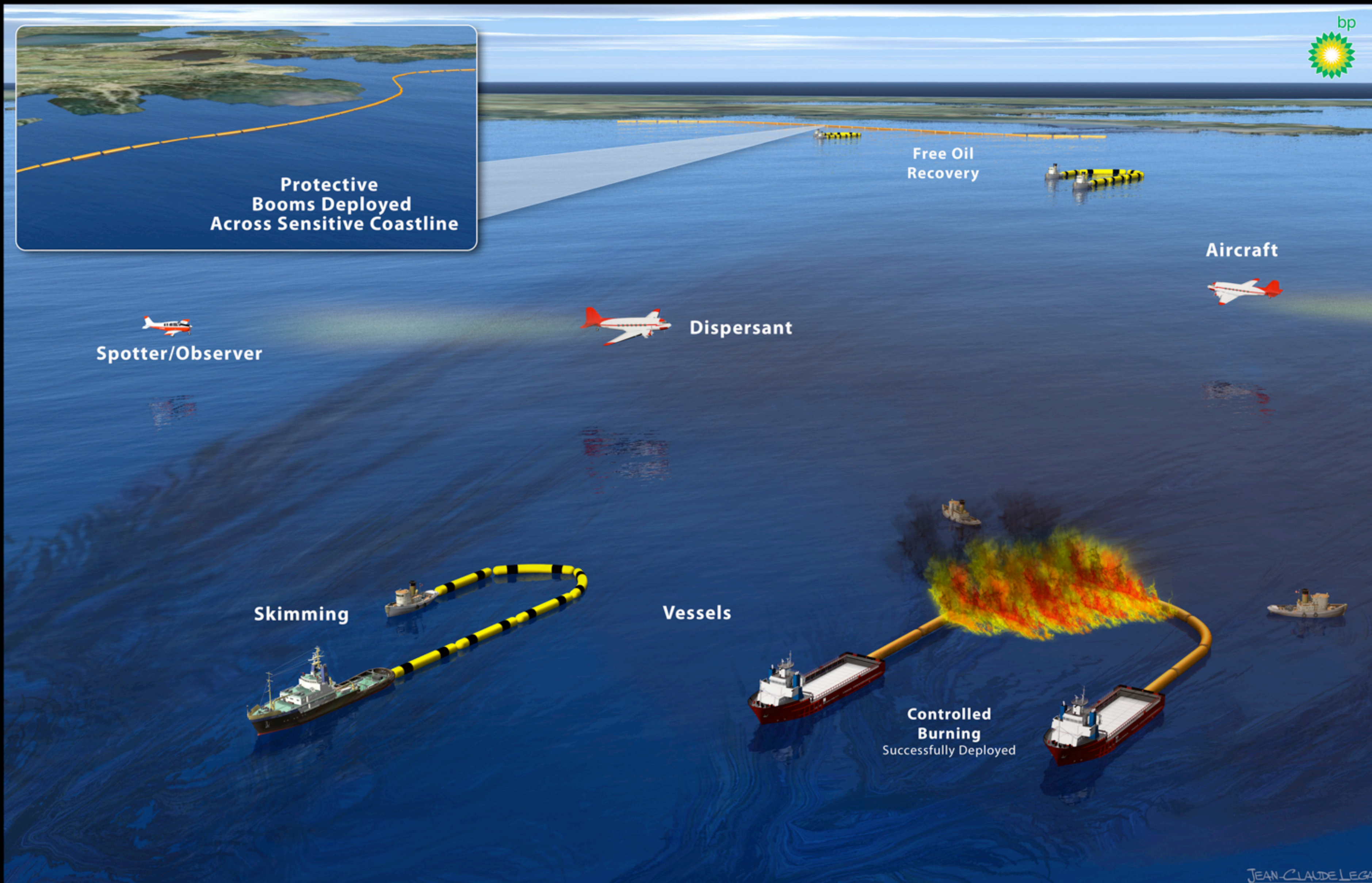

Oil Spill Response Operation

MWCC: Condition for re-issuing deep-water drilling permits was that the industry prove that it could control a deep-sea blowout.

MWCC formed, designed field-deployable capping stack.

Anadarko Petroleum Corporation

Apache

bhpbilliton

bp

Chevron

ConocoPhillips

ExxonMobil

HESS

Statoil

MARINE WELL CONTAINMENT COMPANY

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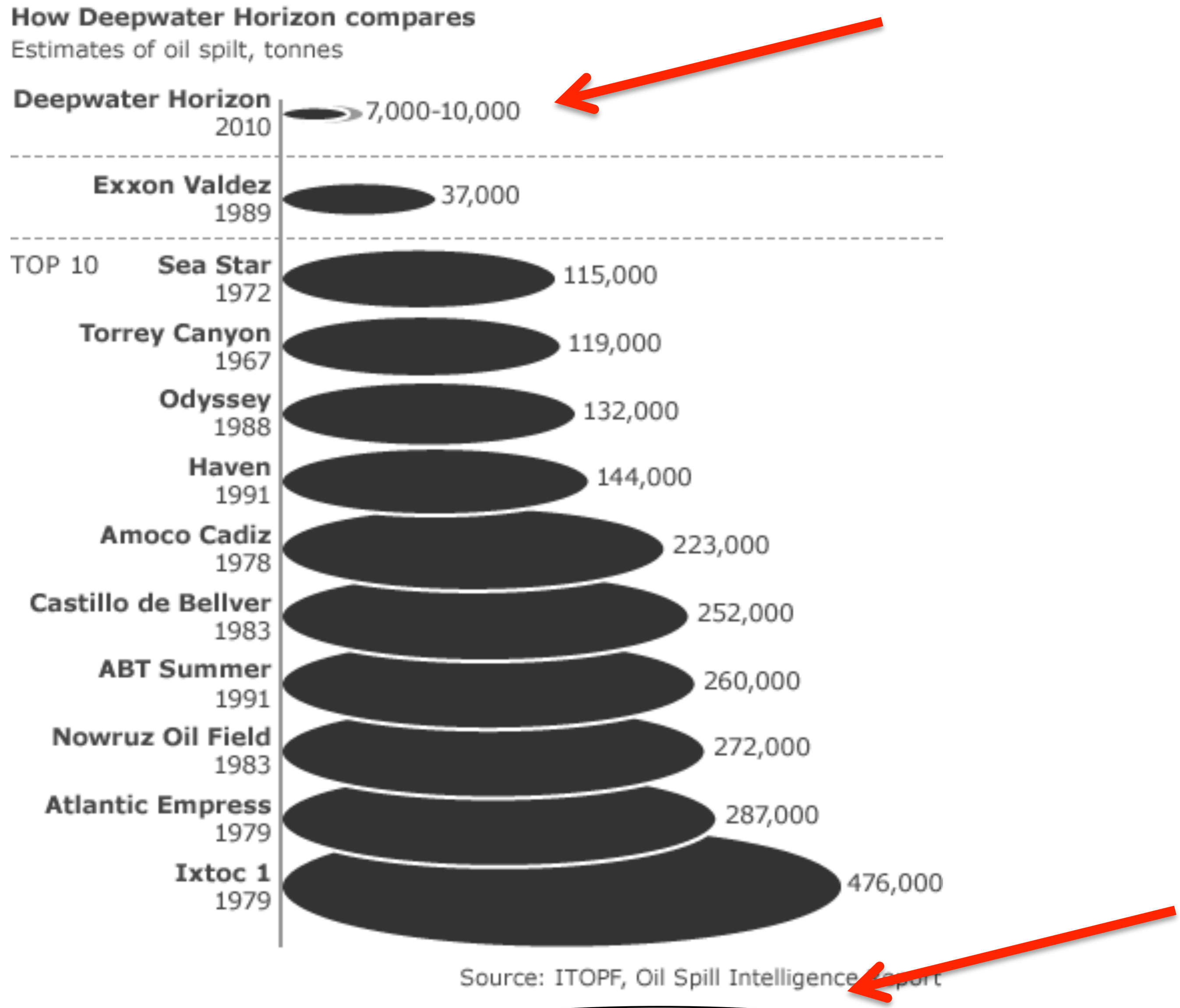
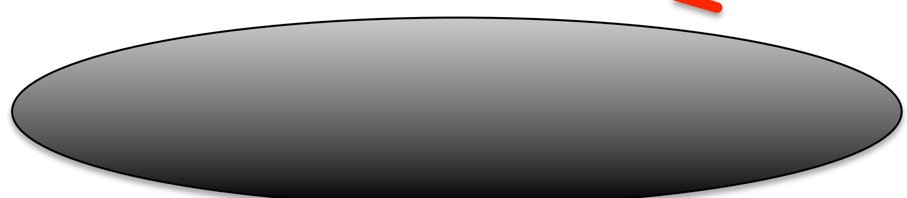
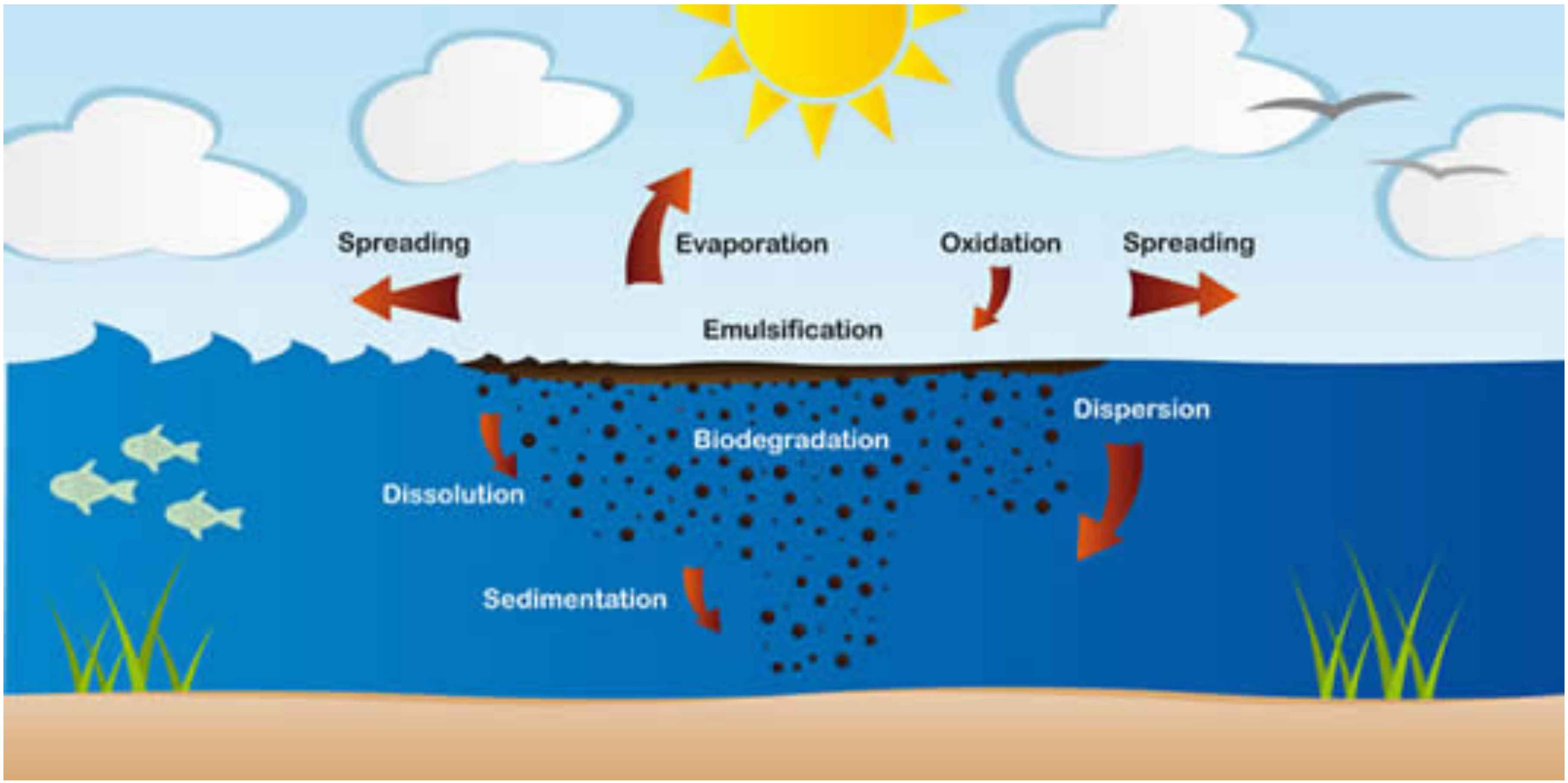
BBC News
May 7, 2010



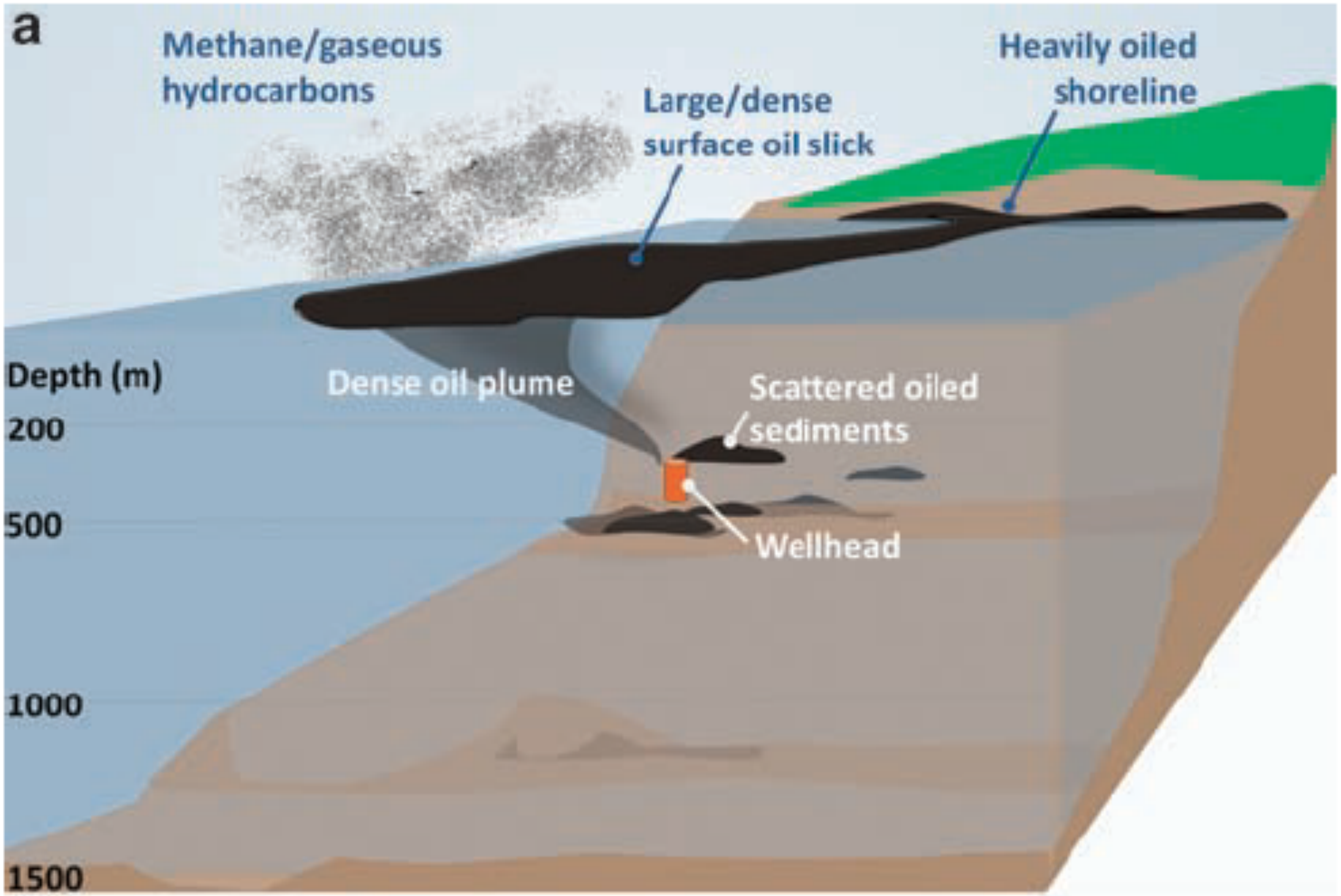
DWH actual: nearly 800,000 tons



Oil fate and transport

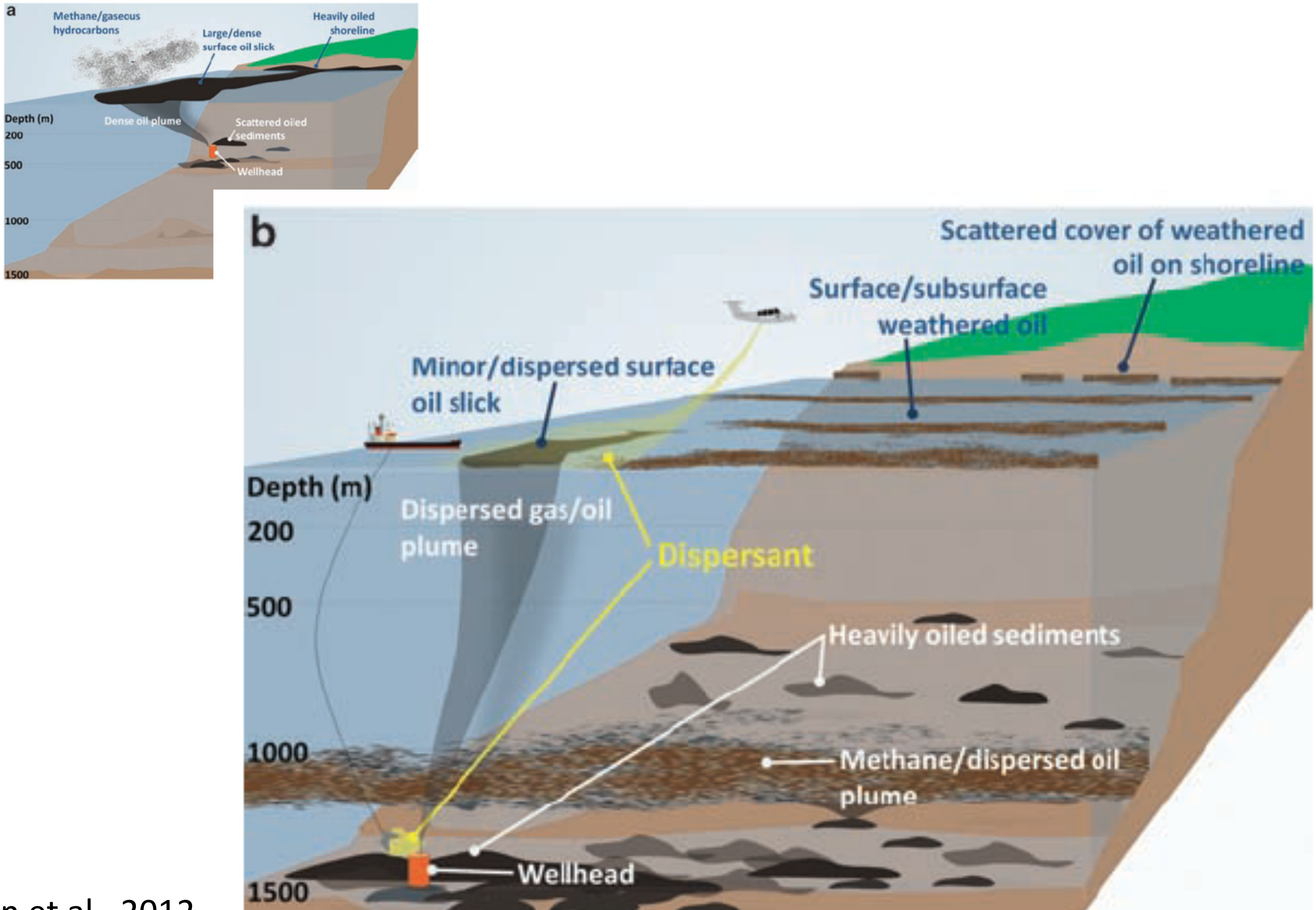


Oil fate and transport – **old** and new paradigms



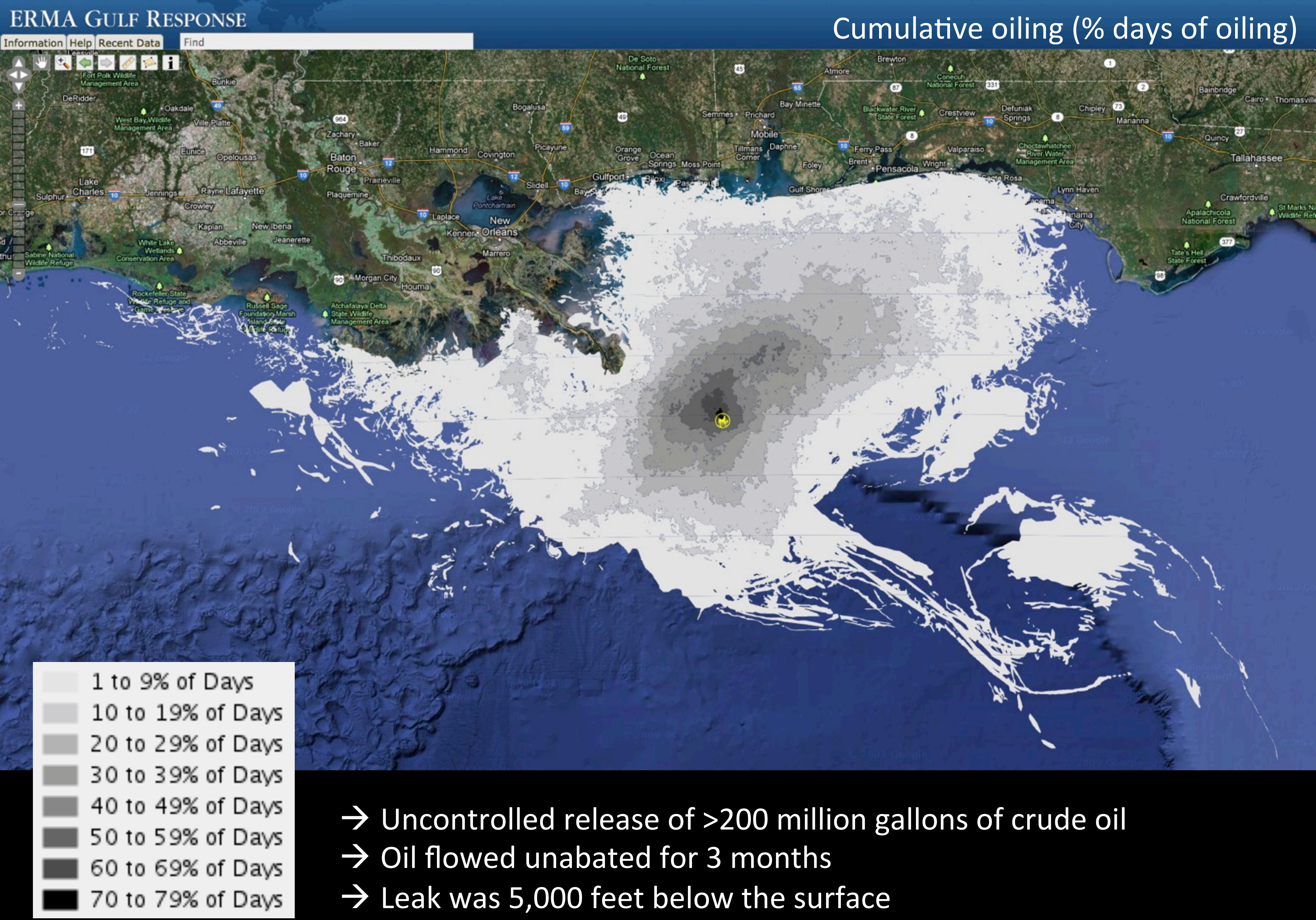
Peterson et al., 2012

Oil fate and transport – old and **new** paradigms



Peterson et al., 2012

Cumulative oiling (% days of oiling)



→ Uncontrolled release of >200 million gallons of crude oil
→ Oil flowed unabated for 3 months
→ Leak was 5,000 feet below the surface
→ 2 million gallons of chemical dispersant applied at surface and depth