Properties & Behaviors of Non-Floating Oils (NFOs)

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Overview

Types of Sinking Oils

- Inherently heavy oils (Group V)
- Floating oils that sink

Some Key Properties

Some Spill Cases

Property & Behavior Considerations

Types of Sunken Oil

- Oils that are heavier than water and mostly sink when spilled
- Oils that are lighter than water and sink after mixing with sediment (several examples)
- Oils that are lighter than water initially but become heavier than water once the lighter fractions are lost by evaporation (very few examples)

Some Key Properties

Density - Will it sink? Relative mass of oil compared to same volume of receiving water

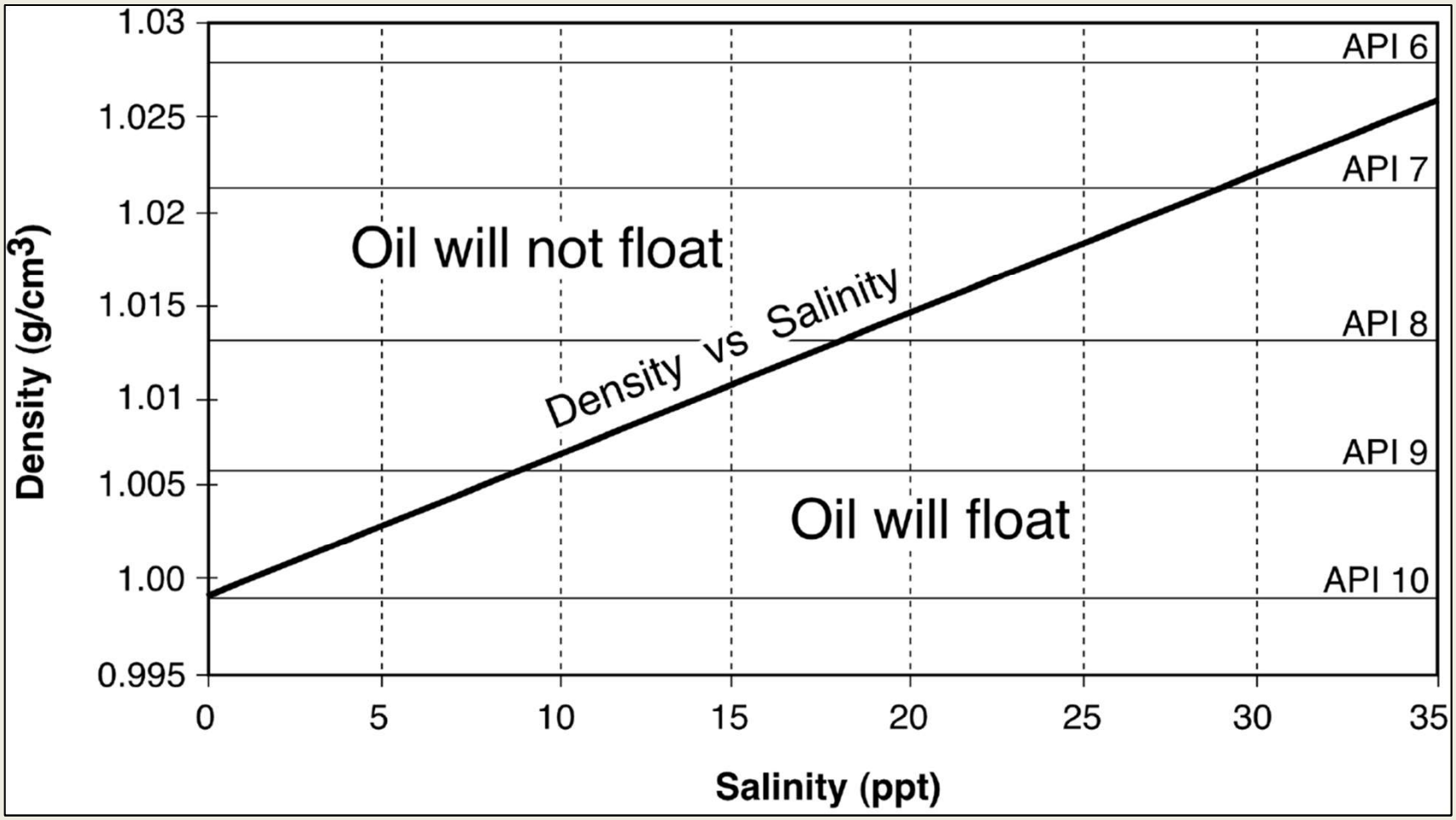
- Spg < 1.0 will float in freshwater
- °API > 10.0 will float in freshwater

Viscosity - Will it flow?

- Affects degree of physical dispersion
- Changes with temperature
- Increases through weathering processes

Persistence - A persistent floating oil may be more likely to pick up sediment

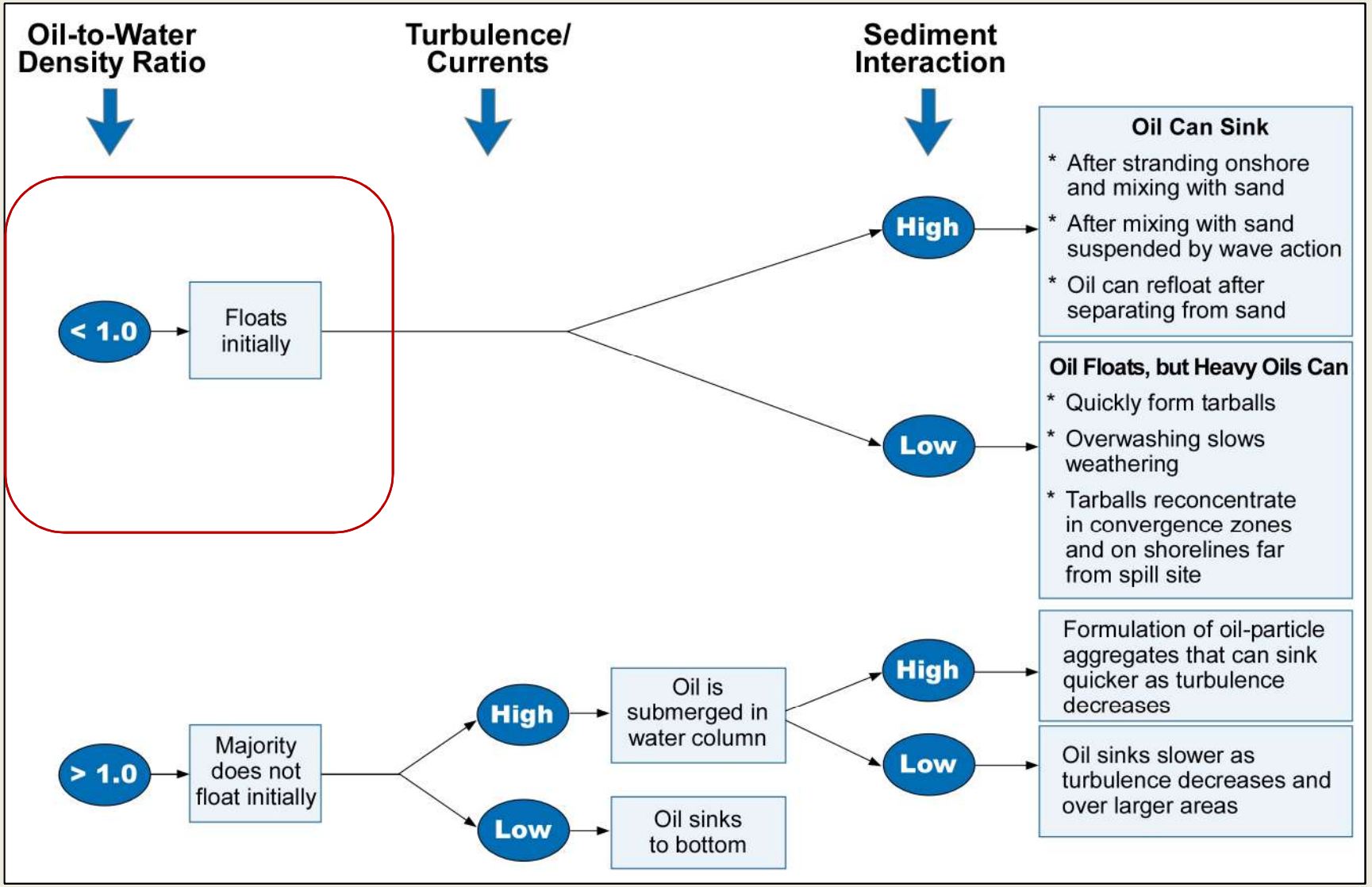
Specific & °API Gravities



From API Technical Report 1154-1 entitled, "**Sunken Oil Detection and Recovery**"

Viscosities of Common Items

Fluid	Viscosity (in cP)
Water	1
Diesel Fuel	10
Olive Oil	100
Glycerin or Castor Oil	1,000
Honey	10,000
Molasses	100,000
Peanut butter	1,000,000



From API Technical Report 1154-1 entitled, "**Sunken Oil Detection and Recovery**"

38 Case Studies in API Report:

19 spills - oil heavier than water and sank to the bottom or was suspended in the water column by strong currents

8 spills - oil initially floated but a significant amount sank after stranding on sand beaches (~2% sand = sinking)

6 spills - oil initially floated but a significant amount then sank or submerged without stranding onshore

2 spills - oil initially floated then became submerged and moved on the bottom with the currents, with little to no accumulation on the bottom

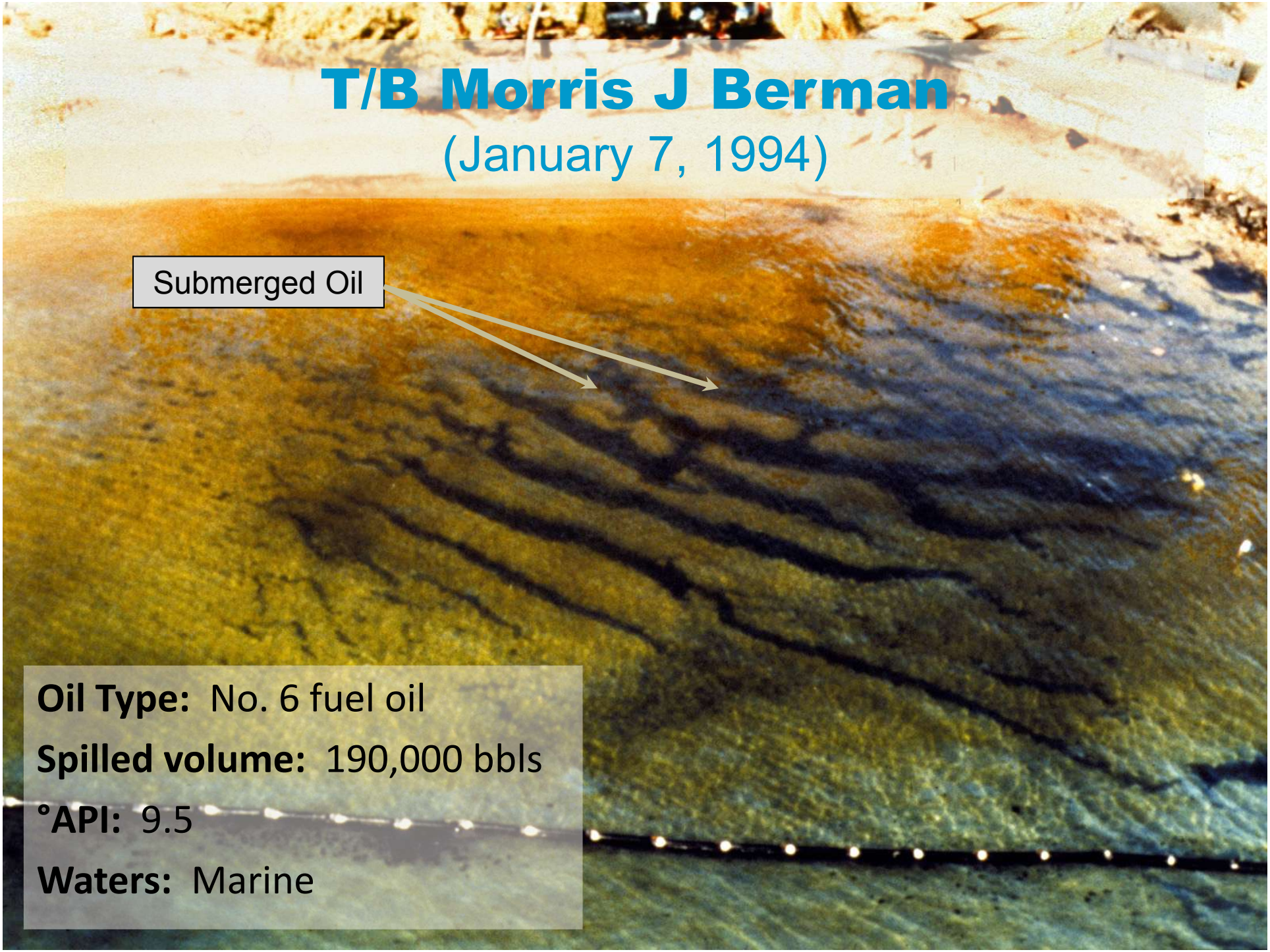
3 spills - oil sank after burning or intense heating

Examples: Spills of initially floating oils

T/B Morris J. Berman (1994) – Heavy fuel oil

M/V Athos I (2004) – Venezuelan crude

Enbridge pipeline (2010) – Canadian dilbit blend


T/B Morris J Berman
(January 7, 1994)
Submerged Oil
Oil Type: No. 6 fuel oil
Spilled volume: 190,000 bbls
°API: 9.5
Waters: Marine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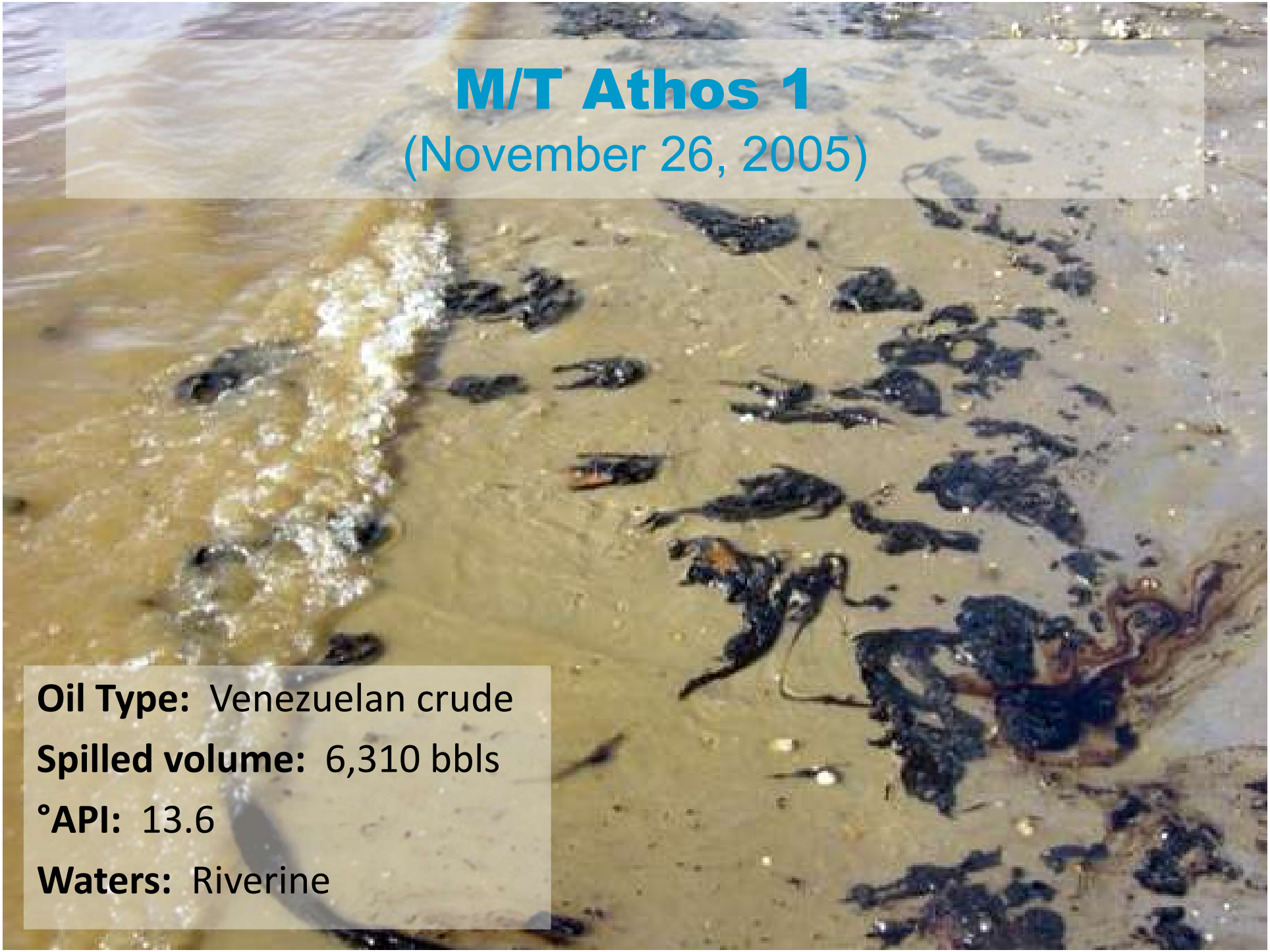

M/T Athos 1
(November 26, 2005)
Oil Type: Venezuelan crude
Spilled volume: 6,310 bbls
°API: 13.6
Waters: Riverine

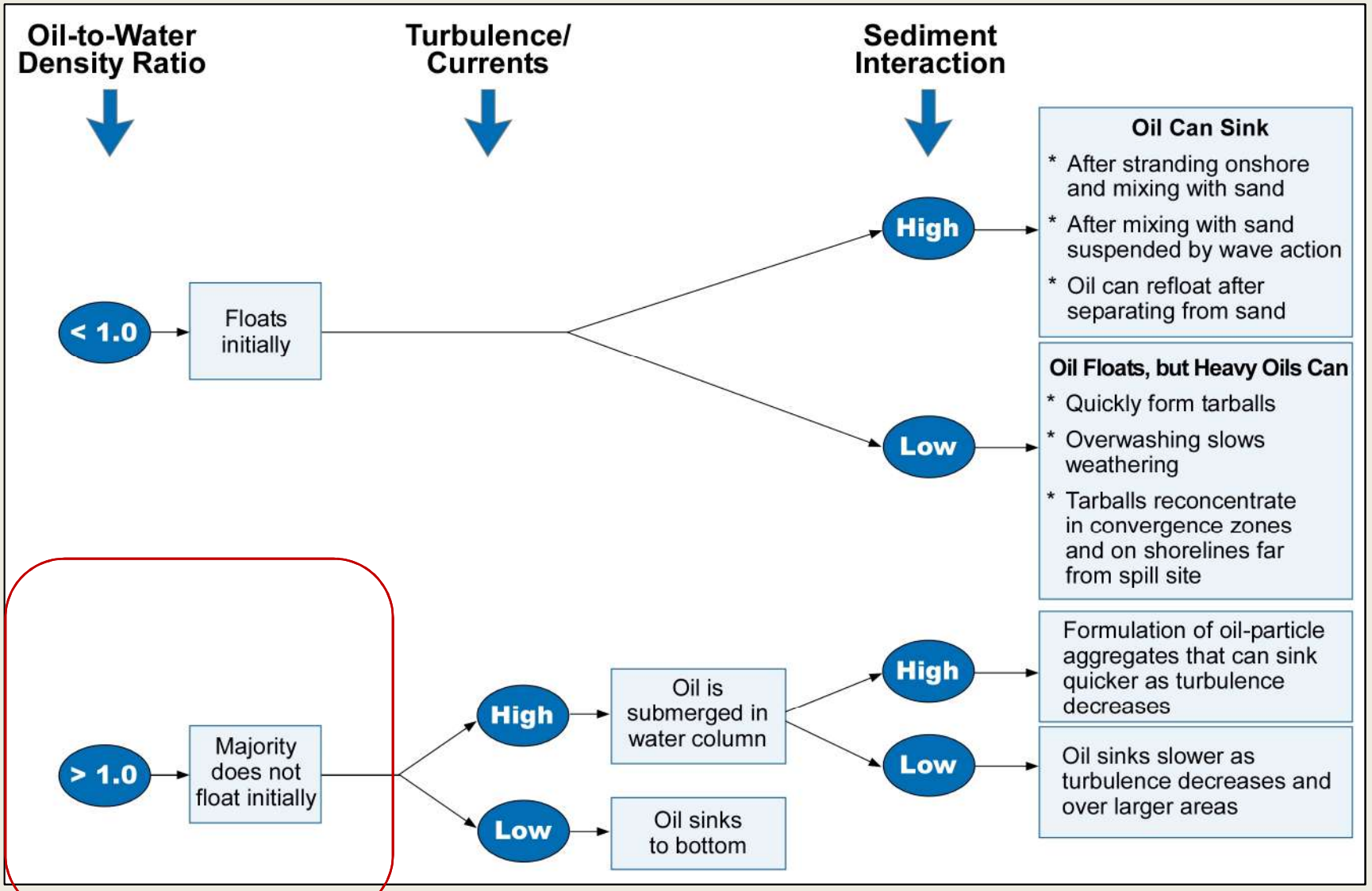

Enbridge NOAA Overflight
Enbridge Pipeline
(July 27, 2010)
Oil Type: Dilbit blend
Spilled volume: 19,500 bbls
°API: ~20
Waters: Riverine
08/03/2010 6:17:46 PM

Enbridge Pipeline

(July 27, 2010)

From

Fate and Transport of Two Diluted Bitumen Products from the Canadian Oil Sands "



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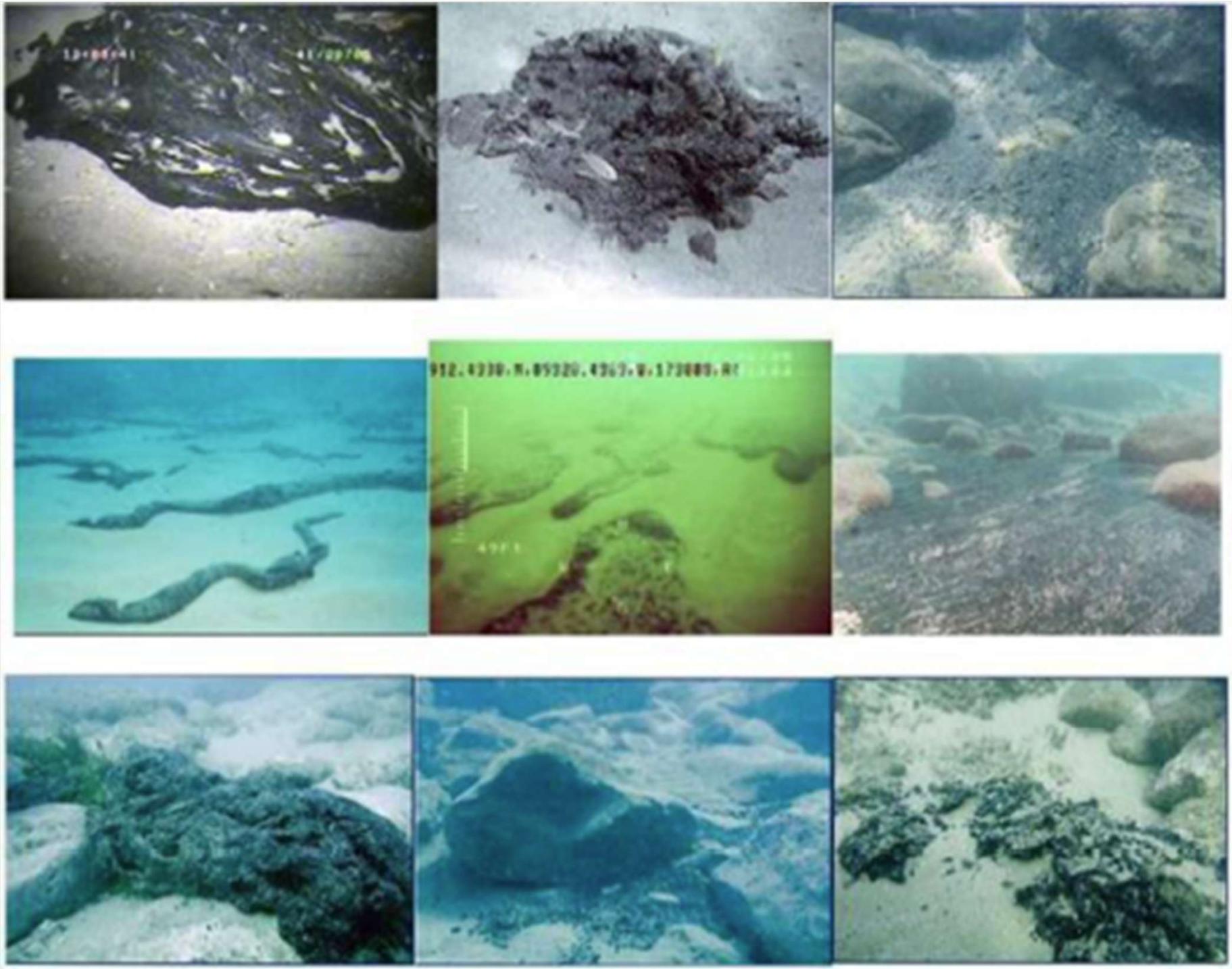


Examples: Spills of sinking oils

SS Sansinena (1976) – Heavy fuel oil

T/B MM-53 (2006) – Asphalt

DBL-152 (2005) – Slurry oil

T/B Apex 3508 (2015) – Clarified slurry oil

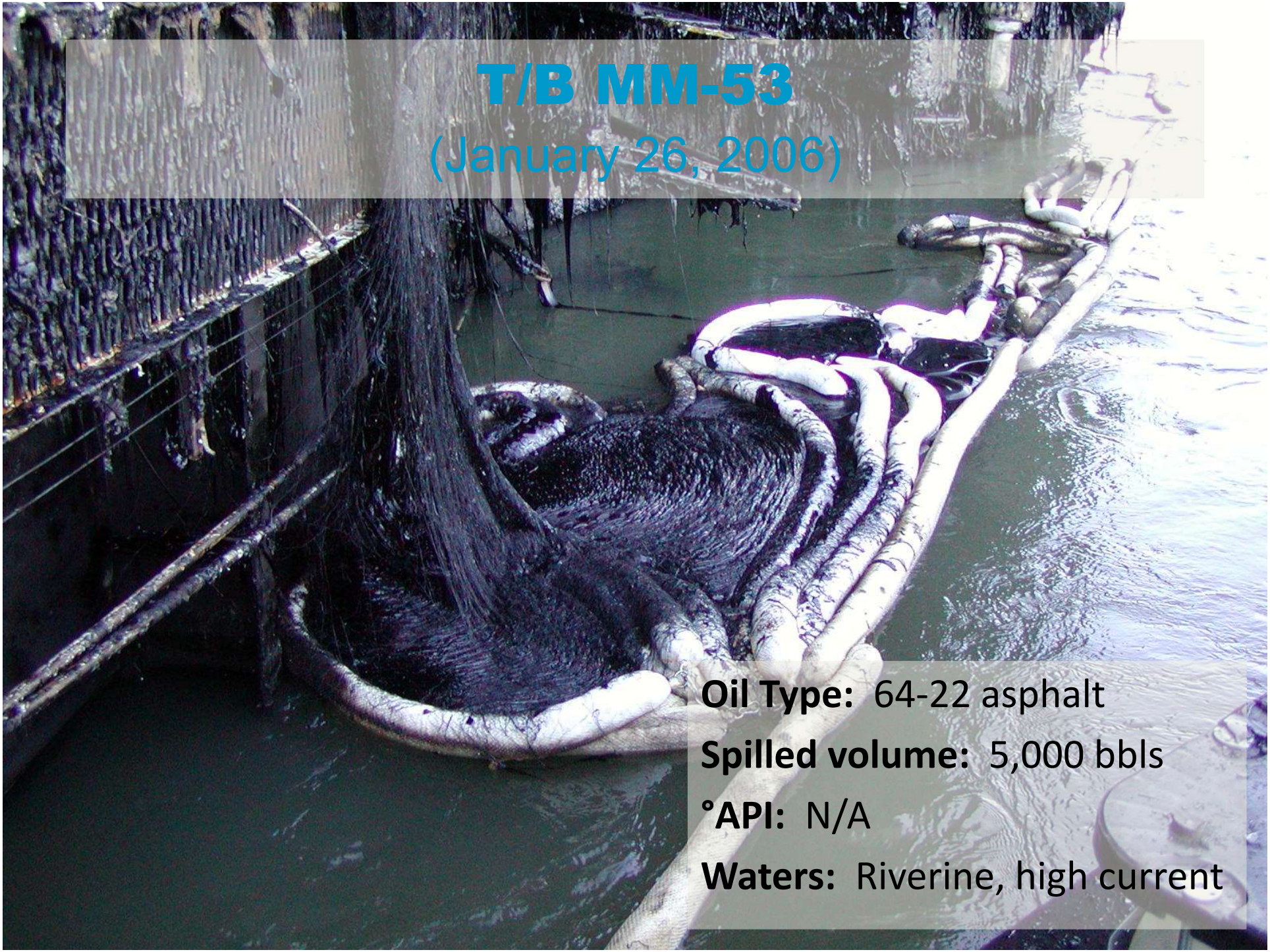
SS Sansinena
(December 17, 1976)

Oil Type: Bunker fuel

Spilled volume: 20,000 bbls

°API: 7.9-8.8

Waters: Marine, low current



T/B MM-53

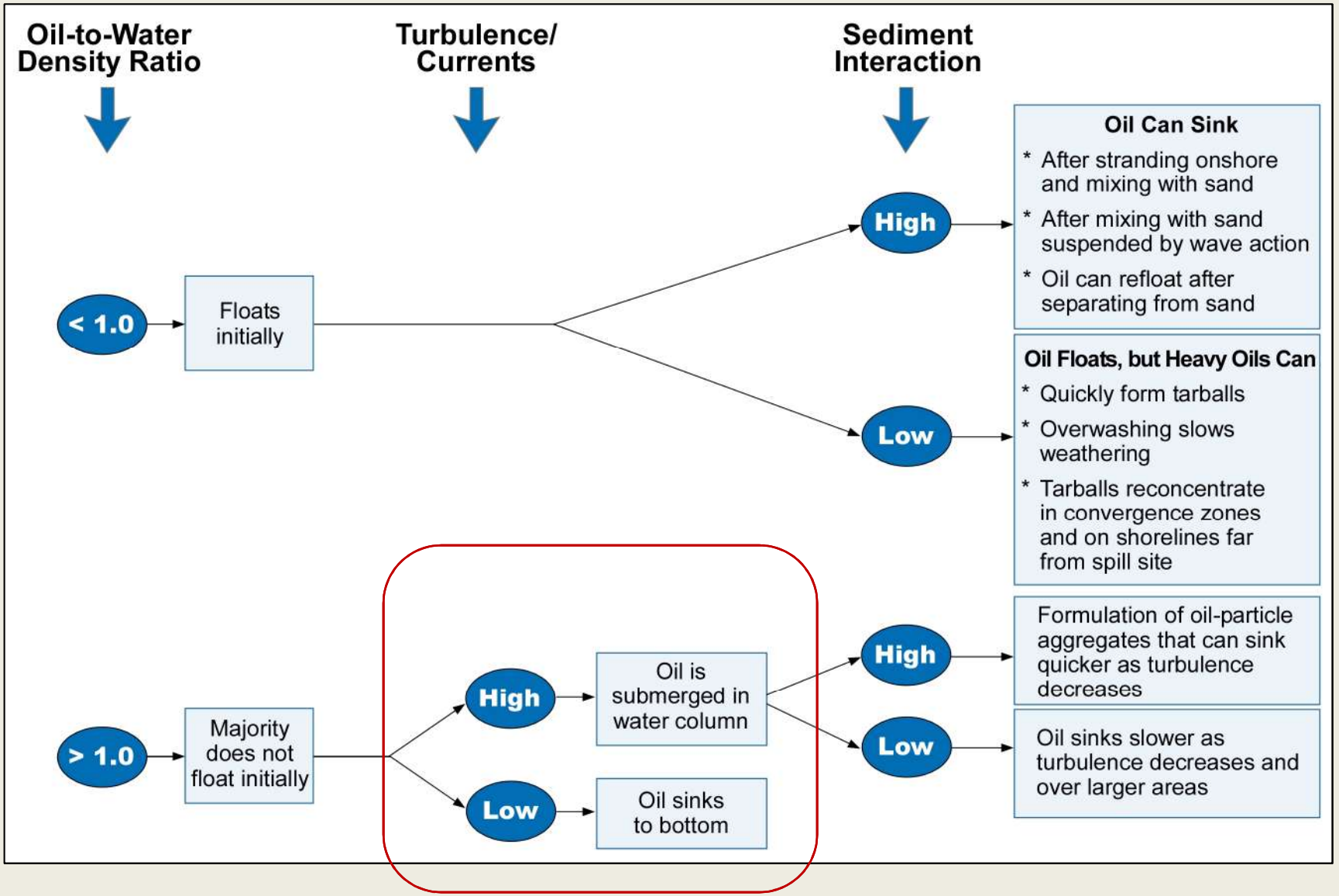
(January 26, 2006)

Oil Type: 64-22 asphalt

Spilled volume: 5,000 bbls

°API: N/A

Waters: Riverine, high current



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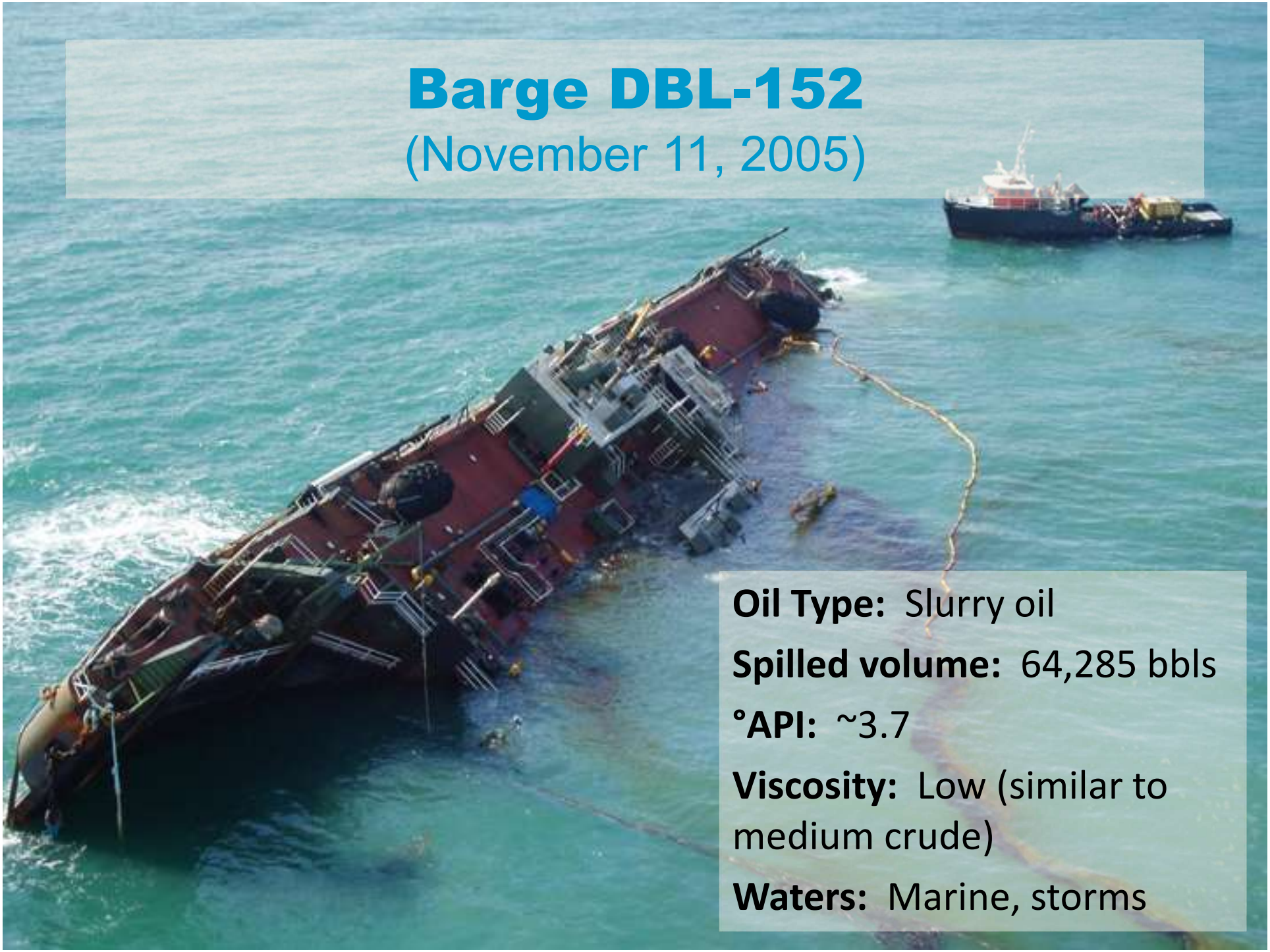
Barge DBL-152

(November 11, 2005)



Oil Type: Slurry oil

Spilled volume: 64,285 bbls

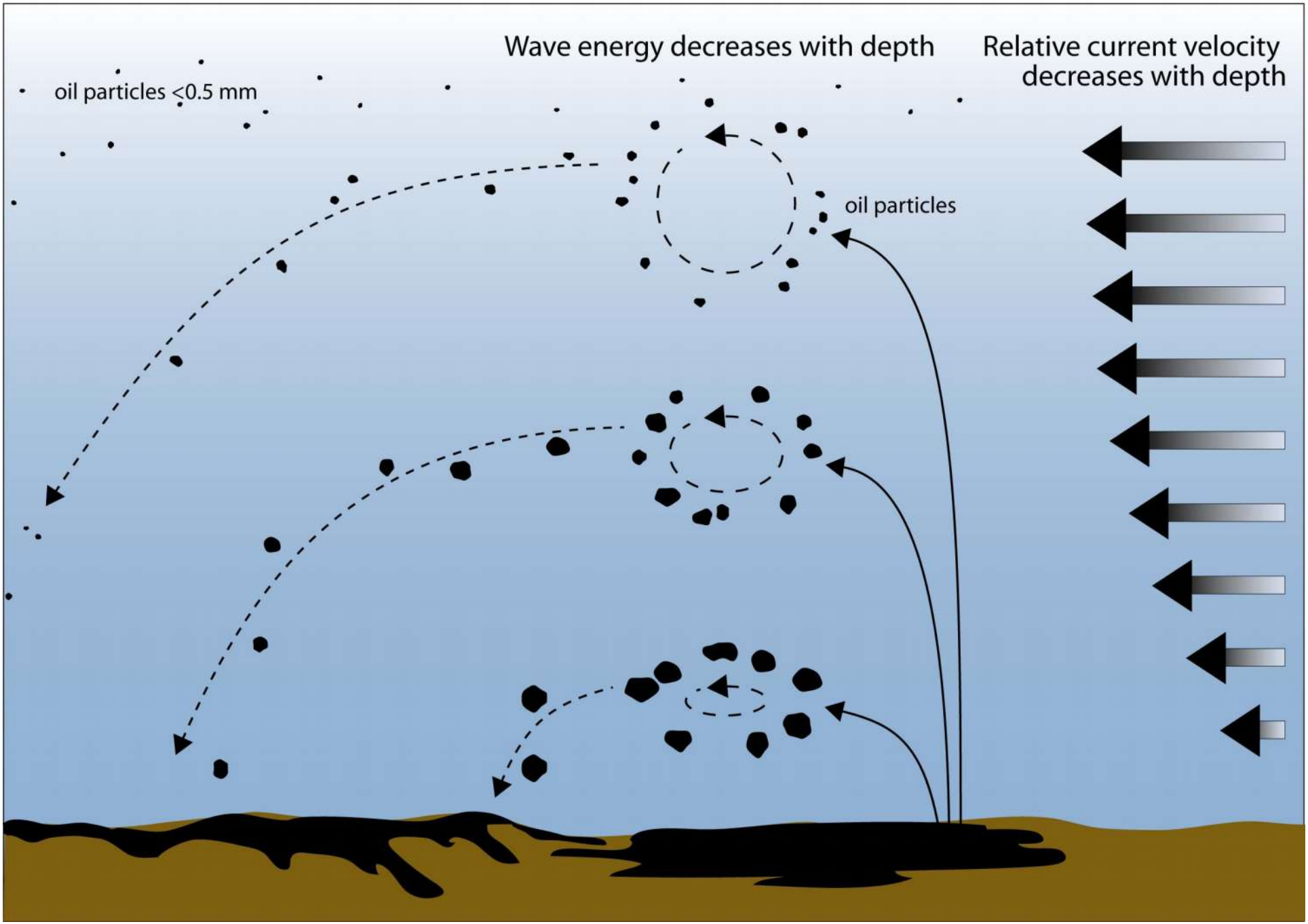
°API: ~3.7

Viscosity: Low (similar to medium crude)

Waters: Marine, storms


USCG
Sample: Composite load sample
Water: Site water (marine)

Re-suspension and Transport of T/B /DBL-152/ Oil



T/B Apex 3508
(September 3, 2015)

Oil Type: Clarified slurry oil

Spilled volume: 2,871 bbls

°API: -7.4

Viscosity: High (thicker than molasses)

Waters: Riverine, low current

Density: 1.14 g/cc

° API: -7.4

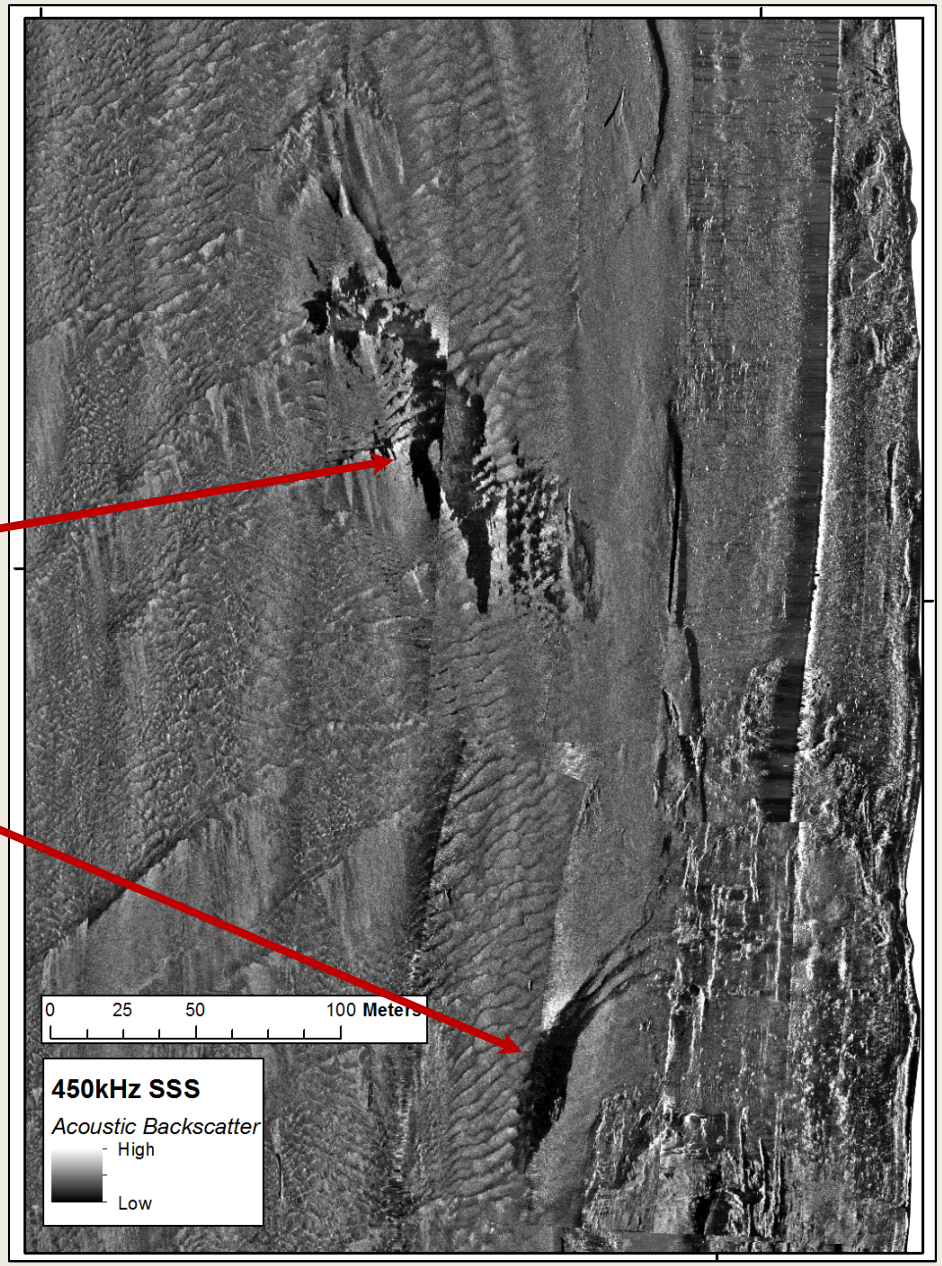
Viscosity: 160,000 cSt

(that's thicker than molasses at room temperature)

High Resolution Side Scan Sonar

Two targets identified:

- Collision site
- Grounded barge site



Property & Behavior Considerations

For all oils:

- Chemical assays are much more informative than SDSs
- Density of oil and receiving waters
- Consider potential for sedimentation
- Consider potential for evaporation to be a factor?

If the parent oil is inherently dense (°API near/below 10)**:**

- Oil viscosity & local currents/turbulence may be important

For Canadian crudes & "dilbits":

- Oil/oil field name are likely more informative than SDSs
- Weathering characteristics of parent oil(s)
- Weathering characteristics of diluent(s)

Questions?

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SB709 Definitions

Nonfloating oil - Oils that does not float on the surface of water either immediately following the spill or at any subsequent time

Potentially nonfloating oil - Oils with an initial specific gravity of less than or equal to 1.0 may become nonfloating over the duration of a spill

Some CA coastal crudes (ºAPIs)

- Coal Oil Point Seep (11.7)
- Platform Irene (11.2)
- Platform Hondo (19.6)
- Platform Gail (20.6)
- Carpinteria (22.9)
- Point Arguello Light (30.3)
- Pitas Point (38.0)

Oil Types

Group 1	Gasoline Products
Group 2	Diesel-like Products/Light Crude Oils
Group 3	Medium Crude Oils/Intermediate Products
Group 4	Heavy Crude Oils/Residual Products
Group 5	Non-floating Oils