Subsurface Dispersant Data for the DWH Oil Spill

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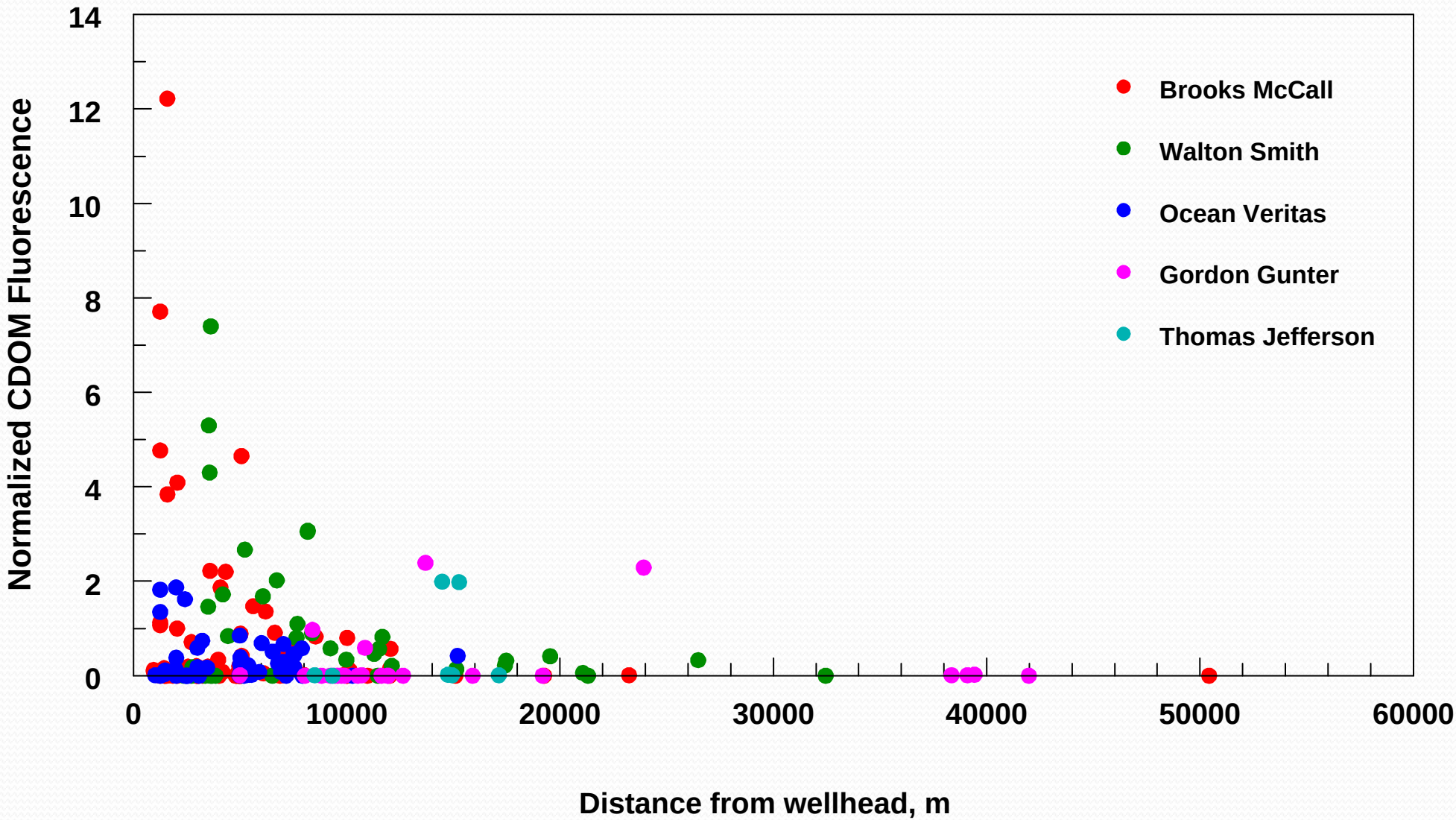
EPA's Dispersant Monitoring and Assessment Directive for Subsurface Dispersant Application

- **Role of EPA: Congressional authority under CWA Subpart J to:**
  - **Issue directives for dispersant use**
- **First directive required BP to implement a monitoring and assessment plan for subsurface and surface use of dispersants**
  - **Shutdown Criteria**
    - **Significant reduction in dissolved oxygen (< 2 mg/L)**
    - **Rotifer acute toxicity tests**
- **Later addenda to implement SMART Tier 3**
  - **Droplet size distribution (LISST)**
  - **CTD instrument equipped with CDOM fluorometer**
  - **Discreet sample collection to measure fluorometry**
  - **Eliminate surface application altogether**
  - **Subsea dispersant use limited to < 15,000 gpd**

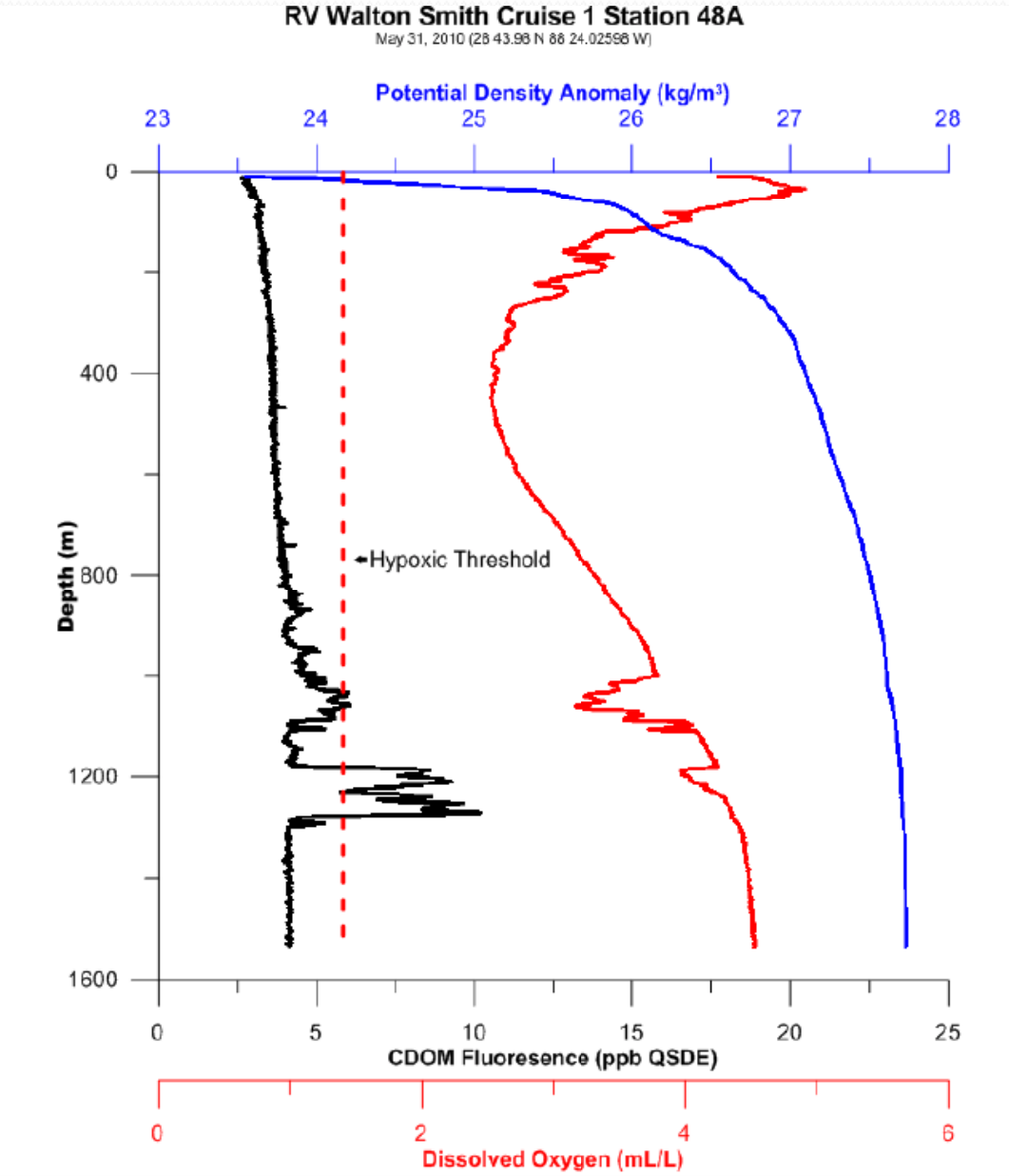
Joint Analysis Group (JAG) for Surface and Subsurface Oceanographic, Oil, and Dispersant Data

- **Working group of scientists from EPA, NOAA, and OSTP**
- **Analyze an evolving database of sub-surface oceanographic data by BP, NOAA, and academic scientists**
- **Near term actions:**
  - **Integrate the data**
  - **Analyze the data to describe the distribution of oil and the oceanographic processes affecting its transport**
  - **Relate to possible biodegradation activities**
  - **Issue periodic reports**

Normalized Mean CDOM Fluorescence (1000-1300 m) vs. Distance from Wellhead



Vertical profile showing 2 DO depressions coincident with fluorescence peaks



Biodegradation Effects on DO in Deep Sea

Biodegradation calculations to determine effect of dispersed oil plume on dissolved oxygen in the deep sea

- **Estimated volume of dispersant used in deep sea injection: 771,300 gallons**
- **Estimated volume of oil dispersed: 52 million gal or 165 million kg (based on specific gravity of 0.84 kg/L)**
- **Assumptions:**
  - **SLC is 80% biodegradable**
  - **Theoretical BOD for mineralizing that mass of oil is 3.5 kg DO/kg oil resulting in 462 million kg DO needed (0.8 x 165 million kg oil x 3.5 kg DO/kg oil)**
  - **Volume of water 300m thick by 32km long by 2.5 km wide gives about 24 billion m3**
  - **DO needed for complete mineralization = 19.3 mg/L (462 million kg DO/24 billion m^3)**
  - **If BOD exerted over a period of 90, 120, or 180 days, amount of DO needed per day to satisfy that demand is 0.21 mg/L/d, 0.16 mg/L/d, or 0.11 mg/L/d, respectively**
  - **Time to reach hypoxic level of 2 mg/L, assuming no replenishment of DO, would be 14, 19, or 27 days, respectively**
- **Hypoxic levels have not occurred, so the DO lost by biodegradation must be getting replenished by vertical and lateral diffusivity of higher DO water**

Effect of Spill on Sediments

- **In the first failed top hat injection of mud, much of the mud was spewed into the water**
- **If oil coated those clay particles, which would eventually sink to the sediment, it could affect the benthic communities**
- **This will need to be evaluated in future research**

Preliminary Conclusions from Spill Response

- **Fluorometry shows recurring anomaly at 1000 to 1300 m**
  - **Strongest near wellhead, decreases with distance**
  - **Trending WSW to NE direction consistent with water movement along isobath**
  - **Natural Organic Matter contributes to fluorescence signal**
  - **Spatial and temporal variability in fluorometric anomalies**
  - **Active natural seeps mapped ~12 km SW and 17 km NE of wellhead**
  - **Minimum detection limit of CDOM fluorometers ~1 ppm oil**
- **Seabird DO anomalies seen at 1000 to 1300 m**
  - **Interpretation pending analysis of Winkler titrations**
  - **If real, impact of biodegradation may not be significant in terms of DO**

Research Areas to Consider

- **Improvements in fluorometric monitoring of dispersed and non-dispersed oil plumes needed**
  - **Questions remain on optimum sensor configuration and NOM interference**
  - **4-D mapping of dispersed oil plumes (leverage with NOAA)**
  - **Improved, innovative laser-based fluorometry (leverage with DFO Canada)**
  - **Better, faster analytical methods for measuring fate and transport of dispersed oil**
- **Biodegradation rates need to be determined quantitatively**
- **Other toxicity methods needed like accelerated EROD assays for shipboard use**

Research Areas to Consider (continued)

- Develop sustainable oil spill mitigation approaches
- Better understanding of water-in-oil emulsions (mousse)
- Assessment of weathering effects on dispersion of oil
- Biodegradability of tar balls and other emulsions
- Exposure assessment scenarios for human and ecosystem effects
- Toxicity testing over many trophic levels
- Development of comparative risk assessments
- Development of modeling approaches to estimate fate and transport of dispersed oil plumes

Helpful Websites

http://www.epa.gov/bpspill/dispersants.html#directives

http://ecowatch.ncddc.noaa.gov/jag/JAG_report_2.pdf

Questions??