Comment on "A Tale of Two Spills: Novel Science and Policy Implications of an Emerging New Oil Spill Model"

The American Petroleum Institute believes that subsea dispersants played a critical role during the *Deepwater Horizon* (DWH) response by reducing the surface oil near the well site. Peterson and his colleagues (2012), however, published an article on post-DWH research and policy priorities questioning the use of subsea dispersants. This letter provides evidence that subsea dispersants worked.

A primary concern is Peterson and his colleagues' statement that subsea dispersants "may have only marginally augmented the high degree of natural oil dispersion" (p. 463). They believe that "the turbulent mixing induced by the pressurized discharge of hot oil and gas into entrained cold seawater was sufficient by itself to induce massive dispersion of oil into fine droplets" (p. 463).

Aerial photos, such as those in figure 1, taken during a 24-hour test of subsea dispersants suggests otherwise. Eleven hours after the subsea injection had begun, the surface near the well had 90% less oil, according to estimates made using these images. The slicks reappeared 5 hours after the injection was stopped.

There are other factors that explain the change on 10 May. Winds and currents could have increased. Wind speed, however, actually decreased. In an evaluation of current data collected near the *Deepwater Discovery III* (NOAA National Data Buoy Center station no. 42916; *www.ndbc.noaa.gov/station_page.php?station=42916*), combined with droplet rise velocities, it was found that the surfacing locations of large oil droplets showed little variability between 9 and 10 May (figure 2).

To support their statement, Peterson and his colleagues referenced Johansen and colleagues (2003), who described a field release of hydrocarbons in approximately 800 meters of water. The data in the report (*www.boemre.gov/tarprojects/377.htm*) underlying Johansen and colleagues (2003) indicate, however, that a significant amount of the crude oil released (untreated with dispersant) may have reached the

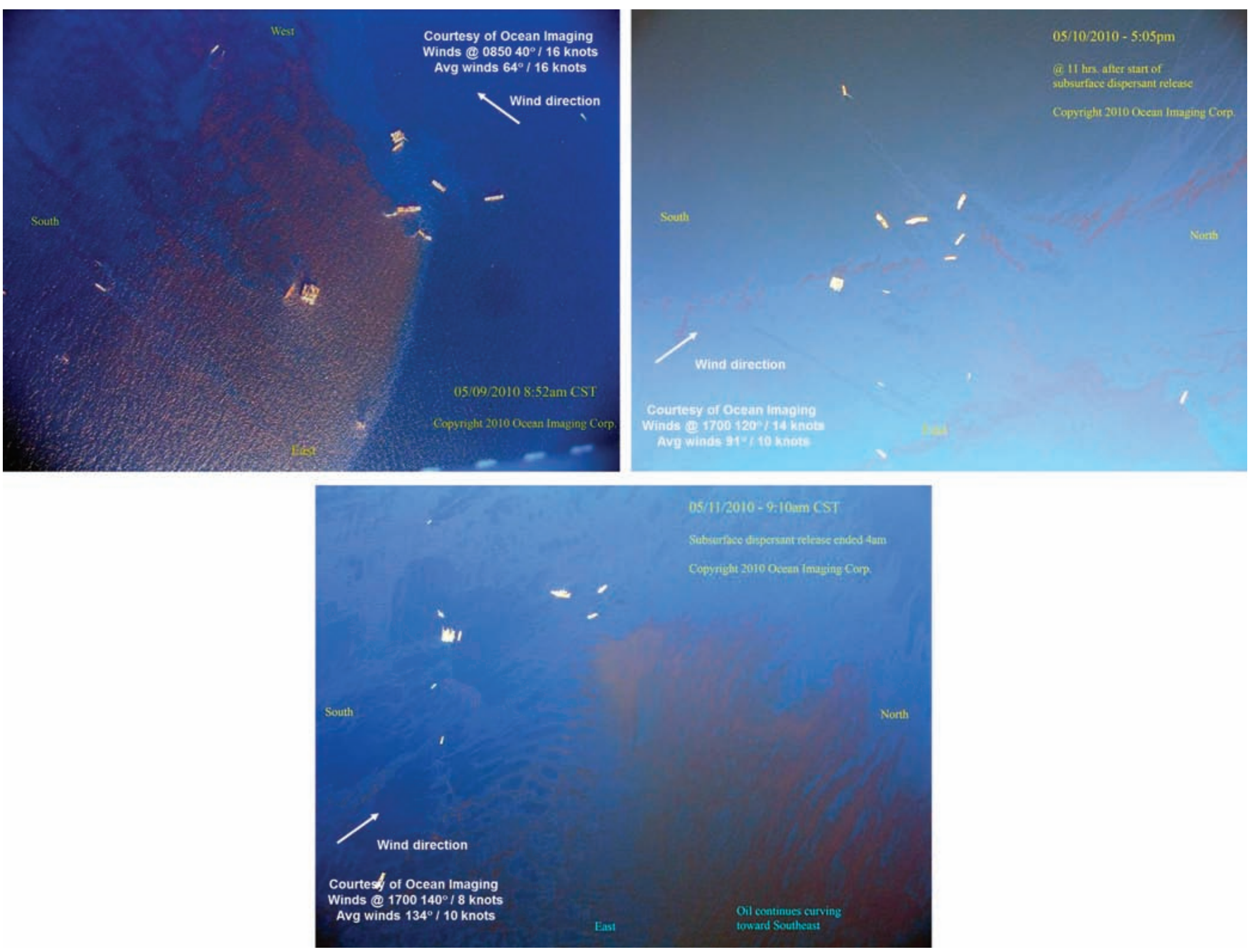

Figure 1. Aerial photos taken over the Macondo well site before the subsea injection (top left, 9 May 2010), 11 hours after start of the dispersant injection (top right, 10 May 2010), and 5 hours after the injection was stopped (bottom, 11 May 2010). Abbreviations: Avg, average; hrs, hours; CST, Central Standard Time.

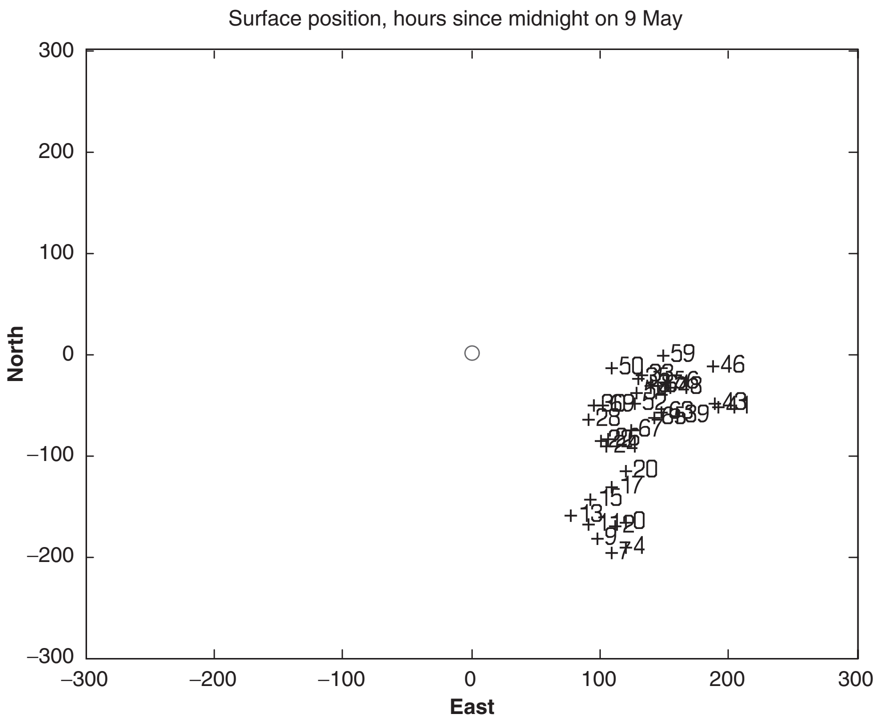

Figure 2. Horizontal surface location (in meters) of large oil droplets relative to the well head (the center circle). The numbers next to the plus sign (+) show the number of hours after midnight on 9 May. To calculate a surface location at a given time, the measured current profile from the **Deepwater Discovery III** *was applied to a 10-millimeter oil droplet (the diameter of a large oil droplet that might form when dispersants are not used) that was assumed to rise at 20 centimeters per second. Although this model is quite simple, it should be adequate to give a relative measure of the importance of ocean currents on the rise of the oil.*

surface. During the crude oil discharge, spotter planes observed a 9 × 1 kilometer sheen at the surface. The sheen was estimated to have a thickness of between 0.3 and 5 microns, which represents 2.7–45 cubic meters of oil. Considering that 50 cubic meters of crude oil was released, a significant amount reached the surface at the low estimate. At the high estimate, 90% of the oil reached the surface!

Furthermore, the role of dispersants is not just to facilitate the formation of small, slowly rising oil droplets but also to hinder recoalescence into larger droplets (Young 1945, Ivanov et al. 1979, Vincent 1983) that rise more rapidly to the surface.

Evidence indicates that subsea dispersants reduced the volatile oil surfacing near the DWH well, which helped protect responders attempting to control the well. Clearly, some oil surfaced, but it was mostly away from the well and in smaller amounts, which helped reduce the amount of oil reaching sensitive shorelines.

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Casual Observations on DWH Dispersant Effects Expose the Lack of Rigorous Science: Response to Rorick and Colleagues

Robin Rorick, of the American Petroleum Institute (API), and his colleagues question our doubt that subsurface dispersant application was required to prevent *Deepwater Horizon* (DWH) oil from reaching the sea surface. The photographs provided as support for the need for and efficacy of subsurface dispersant do not allow scientifically rigorous conclusions in the absence of quantitative measurements of subsurface processes and dynamics of materials transport. Despite our close connectivity to industry, government, and academic research, we are unaware of any compelling, peer-reviewed data documenting the efficacy, necessity, and consequences of subsurface dispersant application during the DWH spill. Rorick and his colleagues' assertions reinforce long-standing concerns that oil spill responses are not based on sufficient science. We expect a higher level of commitment to excellence from an industry capable of so much more.

We questioned the unsupported assumption that the vast majority of hydrocarbon retention at depth is attributable solely to subsurface dispersant use. Rorick and his colleagues' argument regarding Johansen and colleagues (2003) contradicts our understanding of that experiment. In a review of the study, Adams and Socolofsky (2005) noted that, in the absence of dispersants and under even less favorable conditions (shallower, colder, less turbulent water) for generating natural dispersion than those of the DWH blowout, "most oil was not recovered at the surface, suggesting it was in the form of widely dispersed fine droplets" (p. 1). Even assuming that Rorick and his colleagues are correct, their own calculations suggest as little as 5% of the oil may have reached the surface in that study. By emphasizing the dubious high-end estimate of 90%, they reinforce our argument that unequivocal data are not available and that rigorous, process-oriented study is necessary.

Quantifying the behavior, transport, fate, and effects of hydrocarbons from deepwater blowouts, with and without dispersants at various application rates, is fundamental to the public interest. Because subsurface dispersant application is increasingly touted as a necessary new response method, rigorous scientific answers to questions not only of efficacy but also of the impact of subsurface retention of highly dispersed oil-dispersant droplets on particle feeders and an array of other organisms throughout the water column are urgently needed. Such answers do not come from a few photographs. Rorick and his colleagues' restricted focus solely on preventing oil from reaching the sea surface reflects a failure to acknowledge the need for a new oil spill model that includes an assessment of risk below the surface following deepwater blowouts. We welcome formal, process-oriented data and urge API to pursue such studies.

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