Tracking the Degradation of the Cosco Busan Bunker Fuel Oil Spill in San Francisco Bay, California

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On November 7, 2007, the container ship Cosco Busan collided with the San Francisco Bay Bridge spilling 54,000 gallons of bunker fuel oil into the bay. Spilled oil and tar balls were sampled periodically from a small beach and rocky headland at Keil Cove, San Francisco Bay, CA. Nineteen geochemical ratios were used to assess alteration and degradation of the spilled oil using organic biomarker ratios, including n-alkanes, hopanes, steranes, and polycyclic aromatic hydrocarbons (PAHs). Samples were designated either as tar balls or rock tar. The rock tar degradation was influenced by enhanced photo-oxidation due to increased exposure times and physical weathering processes within the tidal zone.

For both the rock tar and tar balls, the low molecular weight (LMW) n-alkanes were removed preferentially along with the 2-ring, and to some extent, the 3-ring PAHs. Parent PAHs were removed more rapidly than their alkylated homologues, suggesting that their respective solubility differences enhanced dissolution and evaporation of the parent PAHs. The C12 to C15 n-alkanes showed significant loss, which may be the result of enhanced evaporation during the first few days of the study. Preferential losses of LMW n-alkanes in the rock tar samples was likely due to increased exposure times and wave action, leading to higher rates of evaporation and dissolution. Following these initial losses, n-alkanes below C27 were preferentially removed by biodegradation. Unlike the PAHs, the saturated n-alkanes were less susceptible to photo-oxidation because they typically require an additional photo-sensitizer. The isoprenoids, pristane and phytane, remained fairly constant in concentration during the length of the study, with ratios close to unity. As expected, the unresolved complex mixture (UCM), indicative of biodegraded and weathered oil, becomes more pronounced over time. Our results imply that the spilled oil will be completely degraded within several years, although areas within San Francisco Bay will likely continue to periodically experience tar ball presence.