

How Much of the Deepwater Horizon's Oil is in the Midwater Plume?

16 May 2010

Jeffrey W. Short, PhD
Pacific Science Director
Oceana

Recent reports of layers of oil released from the Deepwater Horizon accident in the Gulf of Mexico open a new and alarming front on the potential for serious biological impacts. Oil spills usually have their worst effects at the sea-air interface or on impacted shorelines. Creation of metastable clouds of dispersed oil in the mid-water column raises the spectre of large-scale impacts on mid-water and possibly benthic communities on the seafloor.

It is currently not clear how much oil is dispersed in the mid-water clouds. Estimates are fundamentally hampered by BP's lack of interest in measuring the oil leak rate, and by the difficulties associated with estimating the size of the clouds. Recent leakage estimates based on analysis of videos of the oil escaping from the damaged pipe suggest flows on the order of 50,000 barrels per day, equivalent to a total leakage of about 200,000 m³ so far. An even more recent estimate of the size of one of the mid-water oil clouds has dimensions of 10 miles long by 1 mile wide by 300 feet in thickness, equivalent to a volume of 2.4x10⁹ m³. The ratio of these two volumes is about 1:1000, or one mL of oil per L seawater. This suggests that a large fraction of the leaked oil may be in the mid-water oil cloud, and even 10% of this volume of oil would result in an average concentration of 10 uL of oil dispersed

Another way to estimate the amount of dispersed oil in the mid-water clouds is by measuring the depression of oxygen. The very high ratio of surface area to volume of the oil dispersed as microdroplets accelerates microbial oxidation of the hydrocarbons. Recent reports of oxygen depressions of 30% associated with the mid-water clouds of oil suggest the oil volumes are substantial. Unfortunately, oxygen depression at this scale and magnitude has ominous implications for biota in the vicinity.

As the oxygen becomes depleted, the rate of microbial degradation will decline, because oil is much less amenable to degradation under anoxic conditions. Worse, the oxygen-depleted water mass will become toxic for aerobic organisms that encounter it. In addition to organisms enveloped by the oil cloud, organisms that swim into it would also be affected, including those creatures that participate in the diurnal migration from the deep ocean to near-surface waters at nightfall returning to the deep at sunrise. Encountering an anoxic layer would likely be lethal, with their carcasses falling to the seafloor, where their decomposition would add to the oxygen depletion. This could create a vicious cycle that in effect "pumps" anoxic conditions to the seafloor, where it

would kill more organisms there, including ancient forests of deepwater corals and other biota.

Hopefully, BP will re-consider its intransigent position on estimating the oil leakage rate. The lack of reliable estimates erects a serious obstacle for those trying to keep track of where the oil is going, what it's affecting and the magnitude and duration of the impacts. According to Dr. Samantha Joye of University of Georgia, creation of an anoxic dead zone could persist for years and perhaps even decades given the slow ventilation rate of the deep waters of the Gulf of Mexico. If nothing else, a sober appreciation of these impacts is necessary for policy makers and the public to weigh the benefits of oil exploration in challenging environments such as the deep sea or the Arctic shelves with the risks.