Department of Earth Ocean and Atmospheric Sciences Ph.D. Dissertation Defense

# Degradation of Deepwater Horizon oil buried in beach, shelf and slope sediments of the northeastern Gulf of Mexico


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This dissertation project investigated the fate of Deepwater Horizon crude oil components that were buried in Gulf of Mexico beach, shelf and slope sediments. Polycyclic Aromatic Hydrocarbons (PAH) buried in Pensacola sandy beaches posed a potential risk to environmental and human health. A time series study revealed no concentrations exceeding NOAA guidelines and decay to background concentrations within a year. This relatively rapid decay was facilitated by BP's mechanical deep cleaning, which homogenized the sediment, combined with tidal pumping that maintained aerobic conditions within the beach sand. Submerged-oil-mats buried in the surface layers of the inner shelf sands raised the question whether this embedded oil is preserved under anoxic conditions in the shelf sediment. A set of laboratory flume experiments demonstrated that advective pore water flows, generated when bottom currents interact with the ripple topography, transport oxygen to the oil embedded in the permeable sediment. This allows rapid aerobic decomposition of the buried hydrocarbons but also enhances the release of potentially harmful oil compounds to the overlying water. After the Deepwater Horizon oil spill, significant amounts of oil particles and algal cells settled in form of marine snow onto northeastern Gulf of Mexico inner shelf and slope sediments, raising the question how the metabolism of these sediments responded to this fossil and modern organic matter input. The permeable sand sediments and warmer temperatures of the inner shelf in general produced stronger absolute responses by the benthic microbial community, but the relative increases in sediment metabolism were higher in the muddy slope sediments. Co-deposition of oil and algae did not affect the degradation process. The results of this thesis research underline the role of the transport mechanisms for the decomposition of buried petroleum hydrocarbons and provide information to coastal managers and decision makers that can help designing response plans to future oil spills.



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