Synchrotron FTIR Spectral Microscopy Reveals Functional Response of Deep-Sea Microorganisms to the Gulf of Mexico Oil Spill

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The Deepwater Horizon blowout in the Gulf of Mexico on April 20th, 2010 is the largest oil spill in the history of the United States. Their biological effects and expected fate were unknown due partly to the extreme depth and magnitude of this event, and partly to the primary initial mitigation strategy that injected unprecedented quantity of oil dispersant COREXIT 9500 directly at the wellhead (1,544 m below the sea surface). An additional mitigation strategy was to utilize the deep sea microorganisms that could degrade the oil; but this strategy depended on how native microorganisms would respond to an increased concentration of hydrocarbons and/or dispersant *in situ*. A multi-institutional collaboration led by Berkeley Lab researchers discovered that the dispersed hydrocarbon plume stimulated deep-sea psychrophilic γ-proteobacteria. Synchrotron FTIR measurements exhibited spatial and temporal dynamics of spectral features of C=O, NO_x and SO_x vibration modes, giving insights into the in-situ microbial processes by revealing how intrinsic microbes — as seemingly insignificant as an mitigation agent at low temperature and high pressure — could lead to significant molecular changes in hydrocarbon composition with distance from the source at 5°C in the deep-water column of the oil plume in the Gulf of Mexico.

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