

Environmental Lipidomics and the Derisking of Deep Ocean Petroleum Exploration

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We are investigating the lipidome within ocean floor shallow sediments that may host oil-metabolizing microbial communities living in and around active and paleo hydrocarbon seeps located along the Scotian Margin of the Canadian northeastern continental shelf. We hypothesize such lipidomes may act as indirect hydrocarbon indicators of active hydrocarbon seepage in oceanic seafloor sediments. In this regard, we are: 1) developing an environmental lipidomic baseline survey for upper-water column delivered detritus and underlying shallow subsurface sediment microbial communities; 2) to resolve ocean floor seep-specific microbial signatures and to contrast this with what is occurring in the ambient Scotian Slope sediments. We are also evaluating whether fossil core lipids can be used to detect paleoseepage events when accompanying hydrocarbon signatures no longer exist by contrasting the detection of core lipid down-core excursions with terrestrial and upper water column inputs of organic matter and preserved carotenoid photosynthetic pigments. We hope to further measure the isotope compositions of select lipids to constrain hydrocarbon substrate specificity and origin. If successful, environmental lipidomics may prove useful in the develop of a bioassay for the detection of hydrocarbon seepage. To reach these aims, over the last four years we have examined 54 gravity and piston cores reaching to 8 m sediment depths below the seafloor over a geographical area of ~250 km². An additional 65 push cores were recently collected directly at active and paleoseep sites using a remotely operated vehicle (ROV). Altogether, this is one of the most expansive environmental lipidomics surveys to date with tentative results indicating lipidomes do differ depending on the presence and nature of advecting seep fluids.