The Utilization of Intact Polar Lipids to Track Marine Petroleum Systems

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This study aims to develop novel indirect hydrocarbon indicators through the detection of intact polar lipids (IPLs) derived from hydrocarbon oxidizing bacteria and archaea to track active petroleum systems.

To test this, surface and piston core sediments were collected during recent expeditions (*CCGS Hudson* 2015 & 2016; *RV Coriolis* 2017) from the light oil and condensate prone Scotian Margin, Nova Scotia. IPLs were extracted using a modified Bligh & Dyer protocol and analyzed with with ultra-high performance liquid chromatography-mass spectrometry (UHPLC-MS).

Hydrocarbon-positive sites yielded lipid extracts in higher concentration (300-800 µg/g sed.) than hydrocarbon-negative sites (200-300 µg/g sed.). The same trend is reflected in the concentrations of IPLs: archaeal IPLs reach 1000 ng/g sed. in hydrocarbon-positive sites, but only 160 ng/g sed. in hydrocarbon-negative sites. Glycosidic saturated and hydroxylated ether lipids (e.g. 1G-GDGTs, 2G-OH-GDGTs), likely produced by marine benthic archaea, and unsaturated diether glycerols with phosphate-based headgroups (e.g. PE-AEGs, PME-AEGs) likely produced by sulfate-reducing bacteria, have been found in both hydrocarbon-positive and negative sites. Hydrocarbon-positive sites differ by the presence of cardiolipins (DPGs, lyso-DPGs) and an array of unknown lipids, including an unknown series of sphingolipids (Uk-Sph). DPGs have previously been found in sulfate-reducing bacteria. Given that DPGs are only found in hydrocarbon-positive sites, these compounds may derive from hydrocarbon-oxidizing bacteria.

In conclusion, the co-occurrence of DPG and Uk-Sph in combination with elevated TLE and IPL concentrations may be indicative of the presence of marine petroleum systems.