Best practices for the collection, analysis, and interpretation of seabed geochemical samples to evaluate subsurface hydrocarbon generation and entrapment

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Abstract
The detection and measurement of migrated hydrocarbons in near-surface marine sediments is a relatively routine exploration method to investigate issues of hydrocarbon charge. The presence of near-surface migrated thermogenic hydrocarbons provides strong evidence that an active petroleum system is present, as well as critical information on source, maturity and migration pathways. There are multiple methods currently applied by industry to collect, prepare, extract, and analyze migrated hydrocarbons within near-surface marine sediments.

To improve the detection of seabed thermogenic hydrocarbon seepage, core samples should be collected along likely major migration pathways (cross stratal leakage features) identified by conventional deep seismic and high-resolution seafloor imaging technology. Real time imaging provides greater detail to confirm targeted features for more precise core targeting. Not all targeted cores will hit the designated feature and thus collecting replicates along major migration features is critical. Collecting sediment samples below the Zone of Maximum Disturbance (ZMD) to avoid possible transition zone alteration effects and recent organic matter (ROM) masking problems is critical. Choosing a coring device best suited for local seabed conditions will maximize both penetration and sediment recovery.

Multiple sections per core should be collected at variable depths providing a geochemistry profile. Geochemical analysis should include a full range of hydrocarbon types; hydrocarbon gases (C₁ to C₅), gasoline plus range hydrocarbons (C₅ to C₁₂), and high molecular weight hydrocarbons (C₁₂+). Two types of geochemistry samples should be collected; one to capture the volatile light hydrocarbons (C₁ to C₁₂) and non-hydrocarbon gases; and a second for the higher molecular weight hydrocarbons (C₁₂+). The light hydrocarbons require special handling and containers to limit volatile loss and prevent post sampling microbial alteration. Bulk sediment measurements such as quantity of organic matter and sand percent can provide additional important non-geochemical information.

Identification of background versus anomalous populations is critical when evaluating sub-surface migrated seabed hydrocarbons. Sediment hydrocarbons are normally highly altered and may not resemble conventional reservoir oil. Novel petroleum related hydrocarbon compounds need to be examined to fully evaluate organic maturity and source facies.

Mapping thermogenic hydrocarbon seeps (oil and gas) relative to key cross-stratal migration pathways via fluid flow modeling and seismic attribute analysis provides an effective petroleum systems tool to better understand the near-surface petroleum relative to subsurface hydrocarbon generation and entrapment. Bear in mind not all surface geochemical surveys will result in the detection of statistically valid thermogenic hydrocarbon seepage.