



## Microbiological approaches for de-risking offshore deep water oil and gas exploration.

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### Summary

Offshore oil and gas exploration relies heavily on hydrocarbon seep detection through geochemical analyses of seabed sediment cores. Sediment geochemistry can indicate hydrocarbon potential and the presence of working petroleum systems in prospective areas, but does not eliminate the risk of drilling 'dry holes'. With drilling costs in deep water areas reaching hundreds of millions of dollars per well, additional and complementary tools for prospecting are important. Microbiology can offer fresh insight into the hydrocarbon potential in these areas by revealing anomalous diversity patterns or distributions of indicator taxa to help to pinpoint hydrocarbon seeps. In collaboration with other disciplines, we are pursuing multiple microbiological and biogeochemical tools whereby anomaly detection of microbial populations and processes can aid prospecting efforts. These approaches are being tested in deep-sea areas of the Eastern Gulf of Mexico and the Scotian Slope in Atlantic Canada, with samples obtained on piston coring expeditions for surface geochemical prospection. Bacterial community compositions were determined in over 300 sediment samples, from the top few cm down to 10 metres sediment depth. Parallel geochemical analyses followed industry standards for assessing the presence and quantity of petrogenic hydrocarbons, revealing that a fraction of sampling locations in both regions had oil indications. Distributions of bacterial groups known from growth-based studies to be associated with hydrocarbon-degradation, i.e. members of the *Gammaproteobacteria* and *Chloroflexi*, were relatively uniform in Scotian Slope samples. However, a distinct trend was observed in the dominance (>20% relative abundance) of a single taxon affiliated with the relatively undescribed and so far-uncultivated phylum *Atribacteria* in surface and subsurface sediments at sites that were geochemically hydrocarbon-positive. In Gulf of Mexico sediments closely related *Atribacteria* were also detected at higher relative abundance in geochemically 'oil positive' locations. Thermophilic spore-forming *Desulfotomaculum* were also prevalent in these GoM sediments following high temperature incubation assays; the distribution of such thermophiles combined with their possible subsurface reservoir provenance suggest they may offer an additional microbiology strategy for deployment in sediment coring surveys. These mutually exclusive microbiological approaches have the potential to provide evidence complementary to biogeochemical and geochemical seabed prospecting results, positioning microbiology to make strategic contributions towards de-risking exploration in challenging deep water environments.