2018 ASPIRE WHITE PAPER SUBMISSION

Contact Information

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Willing to Attend Workshop?

Yes

Target Name(s)

Atlantic Margin Cold Seeps

Geographic Area(s) of Interest within the North Atlantic Ocean (Indicate all that apply)

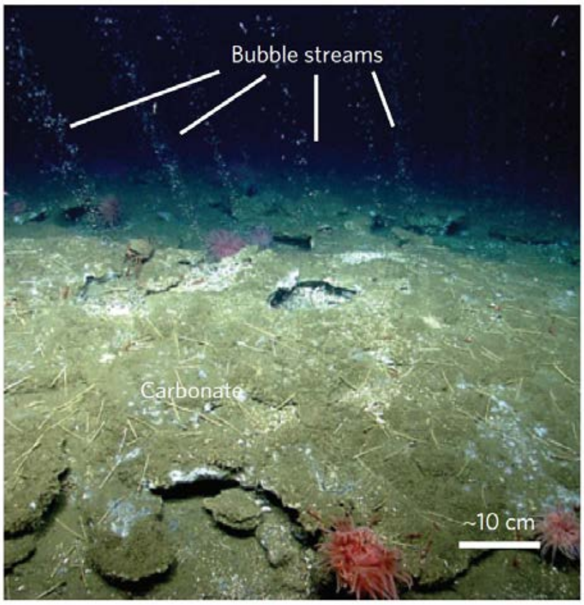
All

Relevant Subject Area(s) (Indicate all that apply)

Geology, Chemistry, Biology, Geophysics

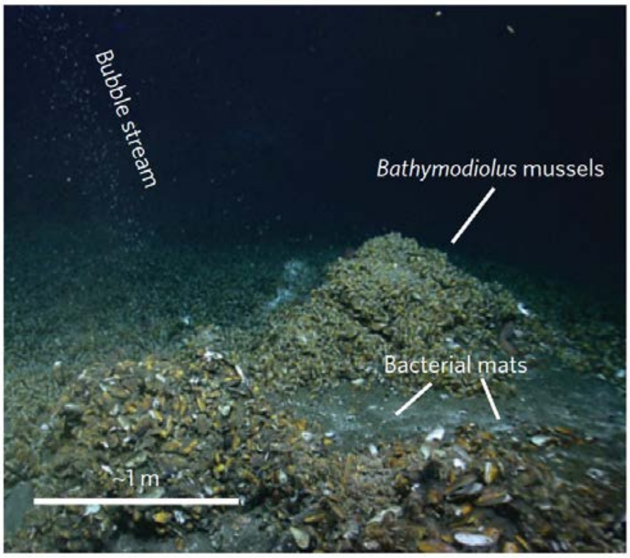
Description of Topic or Region Recommended for Exploration

The first evidence of widespread methane seeps on the Atlantic Margin was described by Brothers et al., (2013) during ACUMEN expeditions, and Skarke et al., (2014) utilized ACUMEN MBES data to report shallow seeps formed due to dissociation of solid methane hydrate. In this area, deeper seeps differ morphologically from shallower seeps, and support distinct chemosynthetic communities and authigenic carbonate mounds (Skarke et al., 2014; Brothers et al., 2013). These morphological differences suggest that geochemistry may be correlative with different habitats, which in turn, yield different MBES responses as suggested by Fisher et al., (2013) in the Gulf of Mexico. The ability to link characteristic seep geochemistry to MBES response along the Atlantic Margin will improve remote sensing methods for determining the extent of hydrocarbon seeps and allow for greater protection and avoidance of these important ecosystems.



ROV videos from 2013 *Okeanos Explorer* expeditions, showed shallow seeps (<600m mbsl) were associated with carbonate crusts, bubble streams, and pockmarks (left, Dive EX1302 no. 10 from Skarke et al., 2014). Thin carbonate crusts were common and benthic communities present at this type of seep typically consisted of small tube worms and bacterial mats. This type of seep is likely to predominantly consist of methane sourced from the dissociation of gas hydrates where seeps exist above the gas hydrate stability zone (Skarke et al., 2014; Brothers et al., 2013).

Seeps described at greater water depths in this area (>1000m mbsl) exist within the gas hydrate stability zone, which suggests gas hydrate dissociation is an unlikely primary source for methane release (Skarke et al., 2014). These seeps display characteristically distinct morphology with thriving benthic communities consisting of chemosynthetic clams, mussels, lobsters, shrimp, and tube worms, as well as massive authigenic carbonate mounds (right, Dive EX1302 no. 4 from Skarke et al., 2014). Skarke et al. also observed that these seeps appear in sublinear clusters (2014), which suggests structural control of seep locations, and may indicate faults are utilized here as migration pathways to the surface for a mixture hydrocarbon fluids from depth.



Although seeps have been identified along the Atlantic Margin, little is known about how different seep morphologies can be differentiated by their MBES response. Furthermore, because different sonar systems, even different settings of the same system, can yield vastly different images of the seafloor, it is necessary that calibration standards of MBES systems be implemented, specifically for backscatter, to improve interpretation of seep morphologies between datasets (Mitchell et al., 2018). If seep communities and their associated morphologies correlate to distinct sources of hydrocarbon seepage as illustrated in the images above, then MBES may be used to characterize the extent of different types of seep communities. This can have broader implications for the protection of ecologically sensitive benthic communities, optimizing resource planning, and providing input to global methane budgets.

To understand the correlation of remotely-sensed seep morphologies to hydrocarbon source, we suggest the following:

- Prioritize seep sites for future survey and dive locations
- Use publicly available MBES data to determine possible locations of cold seeps that can then be used by the *Okeanos Explorer* for future research consideration
- Partner with Fugro to calibrate MBES system so that new data collected during the ASPIRE campaign is specifically optimized for backscatter acquisition
- Collect water samples above seeps for geochemical analysis
    - Characterize seep geochemistry (with Fugro and Academic partners)

Relevant Partnerships (If Applicable)

Fugro, University of Houston, BOEM, University of Texas Institute of Geophysics, University of Alaska Fairbanks