Gas Chemistry of Bubble Plumes and Gas Hydrates along the Cascadia Margin

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The Cascadia Margin along California, Oregon, and Washington is host to hundreds of offshore methane seeps that produce bubble streams that ascend through the water column. Seismic reflection studies have detected extensive bottom simulating reflections (BSRs) along the Cascadia Margin, thought to represent the contrast between methane hydrate overlying free methane gas. During an expedition in 2016, our group used an ROV to collect uncontaminated samples of the bubble stream gas at several Cascadia Margin sites using special gas-tight bottles. This expedition also found sites where hydrate deposits were exposed and visible on the seafloor. Although we successfully obtained samples of the bubble streams, the question remains as to whether the bubble streams are produced by the dissociation of hydrate, or instead represent free gas ascending through the sediment. Our analysis of the free gas shows that it is >99% methane, with trace amounts of higher hydrocarbons, CO_2 and noble gases, including helium isotopes. Our expectation is that comparison of the noble gas composition of the free gas vs. the gas contained in the solid hydrate will help to determine the origin of the free gas bubble streams. Previous attempts to collect uncontaminated samples of solid hydrate have returned the samples to the surface before sampling and have been unsuccessful due to air contamination and gas loss after sample collection. We are developing a sampler in which small samples of hydrate will be hermetically sealed into a small gas-tight volume in-situ while incorporating only a small amount of ambient seawater. During a return expedition to the Cascadia margin in June 2018 we plan to sample hydrate using this new sampler and also collect additional samples of the free gas bubble streams.