

A Happy Marriage

The Haakon Mosby mud volcano (HMMV) is a curious phenomenon. Located off the coast of Norway on the continental shelf of the Barents Sea, HMMV emits mud and methane—not lava—from the Arctic deep. The release of methane from the seabed is particularly troubling in the Arctic. This potent greenhouse gas is estimated to contribute approximately 15 percent to current global warming. Recent studies have suggested

*New
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instruments
open doors to
deep-ocean
exploration*

that warming of the ocean by as little as 1°C could pose a threat to regional or even global ecology.

To Chris German of the Geology and Geophysics Department, and Richard Camilli and Dana Yoerger of the Applied Ocean Physics and Engineering Department, Haakon Mosby represented the perfect natural laboratory to test Camilli's then-new mass spectrometer, TETHYS, a backpack-sized instrument capable of detecting and measuring tiny amounts of specific chemicals in the water. With Arctic Research Initiative funding and an invitation from collaborators in Europe, they mapped a plan to take *Sentry* and TETHYS to the Arctic to measure methane release at HMMV.

Unfortunately, one big crisis stood in the way: The Deepwater Horizon oil spill. In June 2010, Camilli deployed to the Gulf of Mexico, where *Sentry* and TETHYS were able to detect and characterize a plume of hydrocarbons in deep Gulf waters. Haakon Mosby would have to wait.

"We knew that HMMV was a place where we could exploit *Sentry's* range and new instrumentation," German explained. "There's a great deal of concern about methane in the Arctic, and this was a chance for us to demonstrate the Deep

Submergence Lab's latest assets and capabilities, a happy marriage between vehicles and instruments."

Three months later, that's exactly what they did. In September 2010, the team made a series of six *Sentry* dives at HMMV, where they used on-board sonar to image methane bubbles coming up through the water column; employed a new sub-bottom profiler—some six years in the making—to map the mud structures; and deployed TETHYS to conduct *in situ* measurements of HMMV emissions in order to determine if they were carbon dioxide or methane. The results, German said, are very encouraging.

"The sub-bottom profiler has great potential as a system that can be used in the systematic exploration for further cold seep sites along previously uninvestigated ocean margins," he explained. "The *Sentry*-mounted TETHYS mass spectrometer performed without fault on all three dives at the HMMV site, recording over 4,100 discrete sample measurements. *In situ* data recorded during dive operations indicate highly localized methane emission sites."

Another important result of the project was the establishment of stronger collaborations between WHOI researchers and European colleagues investigating the Arctic Ocean through two related programs: ESONET, which is dedicated to establishing a series of ocean observatories encircling the European Margin (of which the HMMV site is just one); and HERMIONE: Hotspot Ecosystem Research and Man's Impact on the Ocean.

Overall, the expedition established that the latest WHOI technologies offer researchers new, cost-effective methods for investigating gas hydrates and associated methane release that can be used not just throughout the Arctic, but along all the world's ocean margins.

OCCI and ARI awarded Chris R. German, Richard Camilli and Dana Yoerger \$382,891 for their project, 'Arctic Warming and Destabilization of Gas Hydrates.'