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March 06, 2012 | By Mario Aguilera

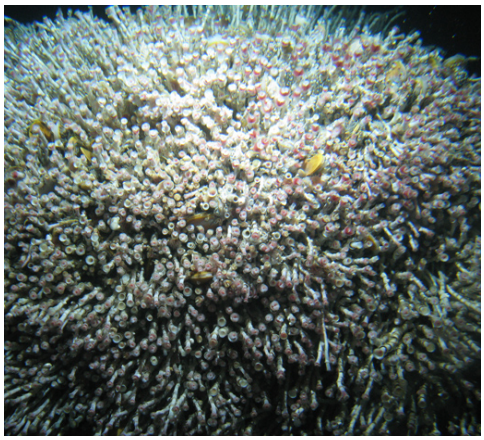
Running Hot and Cold in the Deep Sea: Scientists Explore Rare Environment

Researchers discover unknown species at juncture where hot and cold habitats collide

The symbiosis of an anemone and hermit crab in which the crab uses the anemone as a shell. Photo credit: Greg Rouse

Among the many intriguing aspects of the deep sea, Earth's largest ecosystem, exist environments known as hydrothermal vent systems where hot water surges out from the seafloor. On the flipside the deep sea also features cold areas where methane rises from "seeps" on the ocean bottom.

s estimated that more than 14,000 tubeworms occur in
ound in the deep sea.



It's extremely rare to find both habitat types intersecting in one place, but that's what researchers found and explored during an expedition in 2010 off Costa Rica. A description of the scientists' findings, including a large number of mysterious, undescribed species, is published in a study led by Lisa Levin of Scripps Institution of Oceanography at UC San Diego in the March 7 issue of the *Proceedings of the Royal Society B (Biological Sciences).*

Because researchers who study such areas primarily focus on hydrothermal vent systems *or* methane seeps, Levin and her colleagues were surprised to find a hybrid site in an area where only cold seeps have been previously reported. They coined the phrase "hydrothermal seep" to describe the ecosystem.

"The most interesting aspects of this site are the presence of vent-like and seep-like features together," said Levin, "along with a vast cover of tubeworms over large areas and a wealth of new, undescribed species."

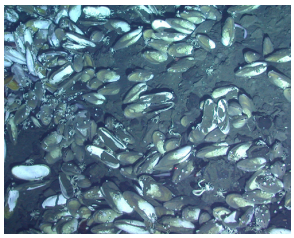
The researchers investigated the geochemical properties of the area—known as the Jaco Scar at the Costa Rica margin where an underwater mountain is moving under a tectonic plate—along with small organisms and microbes. Co-existing animals ranged from those known to primarily inhabit hot vents or cold seeps, along with "foundation" species that exist in both settings. In addition to tube worms the team documented fish, mussels, clam beds and high densities of crabs.

A 'foundation' species of tubeworm found in hot vents an seeps. Photo credit: Greg Rouse

Because so little is known about the deep ocean, the researchers say it's likely that further hybrid or "mosaic" ecosystems remain undiscovered, possibly featuring marine life specialized to live in such an environment.

"There are plenty of surprises left in the deep sea," said Levin, director of the Scripps Center for Marine Biodiversity and Conservation. "Not only are there new species but there are almost certainly new communities and ecosystems to be discovered." "In this instance the human presence, in the submersible *ALVIN*, was key to our findings. The site had

been visited remotely by other researchers, but it was not until human eyes saw shimmering water coming from beneath a large tubeworm bush that we really understood how special Jaco Scar is."



A dense beds of large clams along with snails and crabs.

Coauthors of the paper include Greg Rouse, Geoffrey Cook and Ben Grupe of Scripps Institution of Oceanography; Victoria Orphan and Grayson Chadwick of the California Institute of Technology; Anthony Rathburn of Indiana State University; William Ussler III of Monterey Bay Aquarium Research Institute; Shana Goffredi of Occidental College; Elena Perez of the Natural History Museum in London; Anders Waren of the Swedish Museum of Natural History; and Bruce Strickrott of Woods Hole Oceanographic Institution.

The National Science Foundation supported the research. Assistance was provided by the Centro de Investigación en Ciencias del Mar y Limnología (CIMAR), Universidad de Costa Rica.
