Hydrothermal vents, methane seeps play enormous role in marine life, global climate

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A lush community of vibrant red tube worms grows on a black smoker chimney in the ASHES hydrothermal field. The tube worms, which are hosted in white housings about the diameter of a person's small finger, are intergrown with brown palm worms. Credit: University of Washington, NSF/Ocean Observatories Initiative/Canadian Scientific Submersible Facility

The hydrothermal vents and methane seeps on the ocean floor that were once thought to be geologic and biological oddities are now emerging as

a major force in ocean ecosystems, marine life and global climate.

However, even as researchers learn more about their role in sustaining a healthy Earth, these habitats are being threatened by a wide range of human activities, including deep-sea mining, bottom trawling and energy harvesting, scientists say in a report published in *Frontiers in Marine Science*.

Researchers from Oregon State University first discovered these strange, isolated worlds on the ocean bottom 40 years ago. These habitats surprised the scientific world with reports of hot oozing gases, sulfide chimneys, bizarre tube worms and giant crabs and mussels - life forms that were later found to eat methane and toxic sulfide.

"It was immediately apparent that these hydrothermal vents were incredibly cool," said Andrew Thurber, an assistant professor in the OSU College of Earth, Ocean and Atmospheric Sciences, and co-author on the new report.

"Since then we've learned that these vents and seeps are much more than just some weird fauna, unique biology and strange little ecosystems. Rather than being an anomaly, they are prevalent around the world, both in the deep ocean and shallower areas. They provide an estimated 13 percent of the energy entering the deep sea, make a wide range of marine life possible, and are major players in global climate."

As fountains of marine life, the vents pour out gases and minerals, including sulfide, methane, hydrogen and iron - one of the limiting nutrients in the growth of plankton in large areas of the ocean. In an even more important role, the life forms in these vents and seeps consume 90 percent of the released methane and keep it from entering the atmosphere, where as a greenhouse gas it's 25 times more potent than carbon dioxide.

"We had no idea at first how important this ecological process was to global climate," Thurber said. "Through methane consumption, these life forms are literally saving the planet. There is more methane on the ocean floor than there are other forms of fossil fuels left in the oceans, and if it were all released it would be a doomsday climatic event."

In reviewing the status of these marine geological structures and the life that lives around them, a group of researchers from 14 international universities and organizations have outlined what's been learned in the past four decades and what forces threaten these ecosystems today. The synthesis was supported by the J.M. Kaplan fund.

These vents and seeps, and the marine life that lives there, create rocks and habitat, which in some settings can last tens of thousands of years. They release heat and energy, and form biological hot spots of diversity. They host extensive mussel and clam beds, mounds of shrimp and crab, create some prime fishing habitat and literally fertilize the ocean as zooplankton biomass and abundance increases. While the fluid flows from only a small section of the seafloor, the impact on the ocean is global.

Some of the microorganisms found at these sites are being explored for their potential to help degrade oil spills, or act as a biocatalytic agent for industrial scrubbing of carbon dioxide.

These systems, however, have already been damaged by human exploitation, and others are being targeted, the scientists said. Efforts are beginning to mine them for copper, zinc, lead, gold and silver. Bottom trawling is a special concern, causing physical disturbance that could interfere with seeps, affect habitat and damage other biologic linkages.

Oil, gas or hydrate exploitation may damage seeps. Whaling and logging may interfere with organic matter falling to the ocean floor, which

serves as habitat or stepping stones for species reliant on chemosynthetic energy sources. Waste disposal of munitions, sewage and debris may affect seeps.

The range of ecosystem services these vents and seeps provide is just barely beginning to be understood, researchers said in their report. As many of these habitats fall outside of territorial waters, vent and seep conservation will require international collaboration and cooperation if they are going to continue to provide ecosystem benefits.

More information: Lisa A. Levin et al, Hydrothermal Vents and Methane Seeps: Rethinking the Sphere of Influence, *Frontiers in Marine Science* (2016). DOI: 10.3389/fmars.2016.00072

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