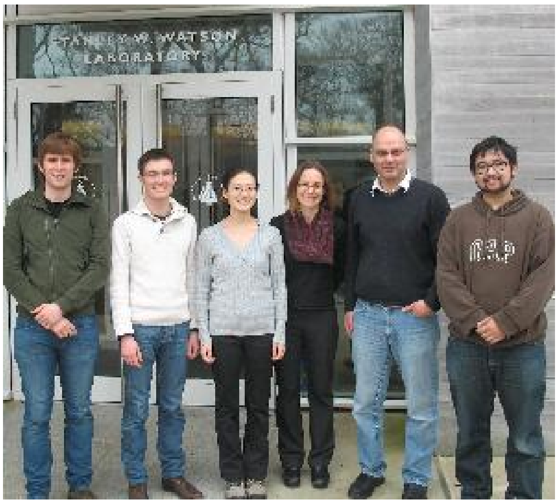
Print

Stefan M. Sievert: Welcome to the Sievert Lab - Studying the Microbial Ecology & Physiology of Dark Life

Overall Research Goals

Marine microorganisms are essential to the maintenance of our biosphere, yet we have only a fragmentary understanding of the diversity and function of microbial life in the oceans. The Microbial Ecology & Physiology Lab studies the composition, diversity, and function of microbial communities, with the objective of understanding the relationship between microorganisms and their role in the ocean biogeochemical cycles. A better understanding of the interactions between the biosphere and geosphere is key to elucidating the role of microbes in the environment, and we contribute to this understanding with our research. The ocean contains a vast array of microbes whose metabolism and physiology remain largely unknown due to a lack of cultivated representatives. This is particularly true for the 'dark ocean', i.e., the parts of the ocean beyond the thin veneer where phototrophic processes dominate. To this end, the Microbial Ecology & Physiology Lab is undertaking analyses of microbial communities that integrate cultivation-dependent and cultivation-independent techniques, and is pursuing approaches beyond the mere description of microbial diversity to help unravel the governing forces behind the patterns of microbial species distribution. Special interests include the microbial ecology of hydrothermal vents including the subseafloor biosphere, microorganisms involved in sulfur cycling, as well as the evolution and the environmental importance of autotrophic carbon fixation pathways other than the Calvin-Benson-Bassham cycle. These so-called alternative carbon fixation pathways are now recognized to be of much greater importance than previoulsy thought (see also Hügler & Sievert, 2011)



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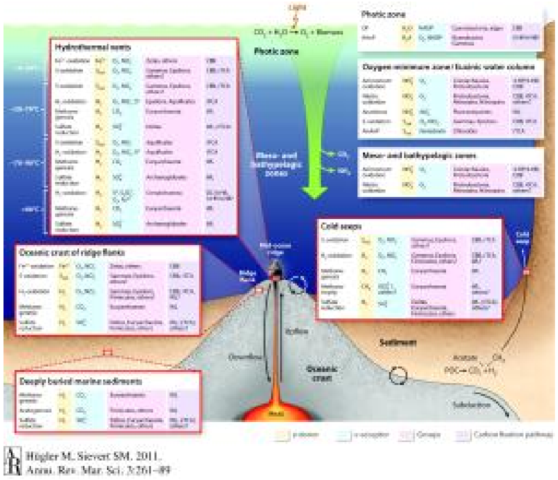
Members of the lab (Spring 2012) in front of the Stanley W. Watson Laboratory for Biogeochemistry (left to right: Jesse McNichol, François Thomas, Ying Zhang, Lara Gulmann, Stefan Sievert, Phil Arevalo).
(Mary Zawoysky)



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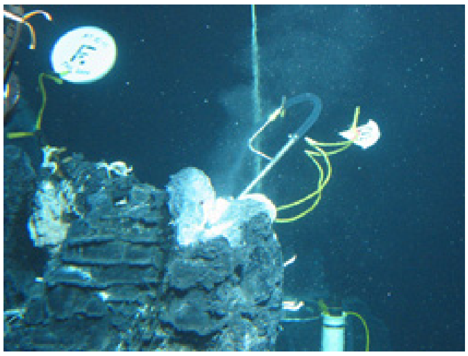
Schematic diagram illustrating where autotrophic processes occur and which particular organisms using alternative carbon fixation pathways play a prominent role in the ocean. See Hügler & Sievert, 2011 for details.

Focus on Autotrophic Microbes in Subseafloor at Deep-Sea Vents

For example, we are currently utilizing molecular biological tools with concomitant analysis of lipids and their stable isotopic compositions as well as microscopic identification of environmental samples and activity measurements to provide a comprehensive assessment of the importance of sulfur oxidation in the subsurface at deep-sea vents. We are attempting to assess the potential importance of carbon fixation pathways other than the Calvin-Benson-Bassham (CBB) cycle for the productivity of this ecosystem. Our present knowledge of organisms responsible for inorganic carbon fixation at hydrothermal vents is inadequate, despite the fact that these organisms form the basis of these ecosystems. Given the prevalence of Epsilonproteobacteria at hydrothermal systems, and the fact that cultivated representatives are autotrophic, it is likely that these organisms contribute significantly to primary organic matter production at hydrothermal vents. These and other autotrophic microbes at vents are using the reductive tricarboxylic acid (TCA) cycle for autotrophic carbon fixation, suggesting that this cycle might be more significant for carbon production at hydrothermal vents than previously thought. Thus, a picture begins to emerge questioning the paradigm of the CBB cycle being at the base of the food web of deep-sea hydrothermal vents.



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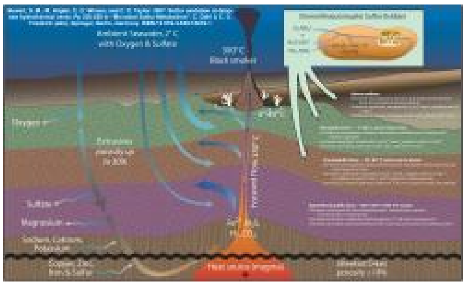
Sampling of hydrothermal fluids at 'Crab Spa'.
(Gavin Eppard, WHOI)

Expedition to Study Subseafloor Life at Deep-Sea Vents

On November 2, 2014, we will embark on an almost 1-month long expedition to the deep-sea hydrothermal vents at 9^{o}N on the East Pacific Rise. On this cruise, we will be using the deep-sea submersible *Alvin* on *R/V Atlantis* to study microbes living on and below the seafloor. The research is funded by the *National Science Foundation*, and it represents a collaboration among scientists from 11 different research institutions from different parts of the world. You can follow the cruise at http://web.whoi.edu/darklife/. Please feel free to check out also our previous expedition earlier this year which was featured on WHOI's *Dive & Discover* website: http://www.divediscover.whoi.edu/expedition15.

Last updated: October 29, 2014



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Schematic diagram depicting a mid-ocean ridge hydrothermal vent site and potential microbial habitats in the subseafloor. (Jack Cook, WHOI Graphic Services)

Related Links

» An Integrated Study of Chemosynthesis at Deep-Sea Vents
Funded by the National Science Foundation's *Dimensions of Biodiversity research program*. Information on currently funded grants in this program can be found here: http://www.nsf.gov/pubs/2012/nsf12053/nsf12053.pdf

» FIX08 cruise on R/V Atlantis
FIX08: An interdisciplinary and international collaboration to study autotrophic carbon fixation and fluid chemistry at 9?N and 13?N EPR

» Microbes That 'Eat' Natural Gas
Scientists identify bacteria that convert chemicals in surprising ways

» "Deep-sea Tubeworms Get Versatile 'Inside' Help"
from *Oceanus* magazine

» Settling on the Seafloor

» Is Life Thriving Deep Beneath the Seafloor?

» "Dark Energy: The Deep Oceanic Biosphere" Workshop, WHOI, 2004

» WHOI's Microbial Biogeochemistry Group

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