DeepZoo field-verification at the EPR on AT50-33

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Project
» RUI: Collaborative: The Predictive Nature of Microbial Biofilms for Cuing Larval Settlement at Deep-Sea Hydrothermal Vents (Vent Settlement Cues)
» Collaborative Research: Life after Death: Do Inactive Sulfides Fuel a Unique Ecosystem at the Deep Seafloor? (Inactive Sulfides)

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Table of Contents

Coverage

Spatial Extent: **Lat**:0 **Lon**:0

[table of contents | back to top]

Parameters

Parameters for this dataset have not yet been identified

[table of contents | back to top]

Project Information

RUI: Collaborative: The Predictive Nature of Microbial Biofilms for Cuing Larval Settlement at Deep-Sea Hydrothermal Vents (Vent Settlement Cues)

Coverage: East Pacific Rise, 9 North hydrothermal vents

NSF Award Abstract:
Over four decades of research have shown that tiny free-swimming offspring of the unique inhabitants of hydrothermal vents can disperse effectively between their specialized habitats. Yet, we know almost nothing about how these larval animals complete the journey by locating and settling down in suitable locations. This question remains one of the key unresolved puzzles in the ecology of the deep sea and is becoming increasingly important to solve as hydrothermal vents are becoming threatened by human impacts. The investigators suggest that the films of bacteria that first form at vents are good signposts for settlement of larvae because they indicate that the hydrothermal vents are suitable for life. This project uses a combined program of field experiments, cutting-edge molecular biology techniques, and shipboard experiments with

hydrothermal-vent larvae and cultured bacterial films. The project also connects undergraduate research interns at a primarily undergraduate institution (Western Washington University) with undergraduate research interns at two research institutions (Rutgers and Woods Hole Oceanographic Institution) while working on the project at sea together. Finally, the team is producing a science-in-action documentary filled with ocean science and exploration intended for television distribution and museum screenings. The investigators are using footage of the deep-sea vents, shipboard and diving operations, and laboratory work to create a documentary that highlights the foundation of scientific research—hypothesis-driven research, the application of the scientific method, and the importance of critical thinking—all in the framework of the study of an exciting, but threatened, ecosystem.

Hydrothermal vents are particularly tractable systems in which to study questions about the roles of biofilms in larval settlement because biofilms at vents are relatively low-complexity; vent animals are strictly dependent on vent microbes, often through symbiotic partnerships acquired after settlement; and environmental variations are present within the range of a common larval pool. Moreover, decades of research on settlement in model organisms give us good insight into biofilm cues; there is solid foundational understanding about colonization patterns at vents; we now have excellent tools to collect, identify, and culture vent larvae and microbes; and modern environmental "-omics" techniques are a good tool to characterize biological cues produced by biofilms. The project provides an unprecedented, quantitative look into the role of microbial biofilms in structuring larval settlement at hydrothermal vents, achieved only through the close collaboration of microbial and larval ecologists. The combined field program of short-term settlement experiments, microbial "-omics" work, and subsequent shipboard settlement experiments allows the investigative team to use field experiments to statistically model the factors that best predict larval settlement in the field, then test those predictions with shipboard experiments that decouple covarying conditions. This extensive characterization of putative larval settlement cues and their relationship to colonization success in heterogeneous vent habitat niches will contribute to a broader understanding of colonization success across diverse marine ecosystems. Understanding the role that the initial settlement of larvae plays in the recovery and resilience of hydrothermal-vent ecosystems is critical to developing informed management plans for deep-sea mining.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

Collaborative Research: Life after Death: Do Inactive Sulfides Fuel a Unique Ecosystem at the Deep Seafloor? (Inactive Sulfides)

Coverage: East Pacific Rise near 10 N

NSF Award Abstract:
This project is investigating a newly discovered community of animals and microbes near deep-sea hydrothermal vents that appears to inhabit only cool, inactive sulfide features. The main objectives are to determine what species live on these features, whether they are new to science, and how they function in the community. The discovery of this novel community, which may be fueled by production of resident microbes, is likely to change the way we think about inactive vents and their contribution to deep-sea biodiversity and productivity. This project has broad impact in four different areas: 1) Informing policy for sustainable use (mining) of inactive sulfides; 2) Contributing to global data systems and the NSF-funded repository at BCO-DMO to make our data available for research use at other temporal, spatial, and taxonomic scales; 3) Increasing public scientific literacy by enhancing K-12 education in the sciences at Memorial Junior High in Eagle Pass TX with about 98% Hispanic and 2% Native American students and a high number of English Language Learners and migrants; and 4) Developing a diverse workforce by engaging students from under-represented and marginalized groups into undergraduate intern programs.

Hydrothermal venting of heated, reduced fluids from the seafloor occurs globally at plate tectonic boundaries and mid-plate hotspots and has been the subject of vigorous geological, chemical and biological research. However, this venting is ultimately transient, leaving behind only the sulfide mineral-rich deposits after the fluid flow stops. This project investigates the organisms living on these lesser studied inactive sulfide features in order to understand their ecology and associations with the mineral substratum. Recent discoveries indicate that some microbial and animal species inhabiting inactive sulfides are not found elsewhere in the marine environment, suggesting the sulfides serve as a unique habitat, distinct from other seafloor topographic features. The main project objectives are to characterize the species and functional diversity of the inactive sulfide ecosystem across all three domains of life (eukaryotic, bacterial, and archaeal), determine which animal

species are endemic or predominantly associated with inactive sulfides, and explore the biological and geological characteristics governing those associations. The investigators are conducting field studies between 9-10 degrees N on the East Pacific Rise at sites within the axial summit trough as well as at recently discovered off-axis sites away from modern day venting features. The discovery of this novel community of organisms inhabiting inactive sulfide features at hydrothermal vent fields, fueled by resident chemolithotrophic microorganisms, is likely to change the way we think about the role of these ecosystems in deep-sea biodiversity and productivity.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

[table of contents | back to top]

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[table of contents | back to top]