Deep Ocean Exploration Institute
Final Project Report (25091107)

Collaborative Studies of Post-eruption Colonization Dynamics on EPR Vents
Lauren S. Mullineaux and Susan W. Mills, Biology Department

What were the primary questions you were trying to address with this research? (Or, if more appropriate, was there a hypothesis or theory that you were trying to prove or disprove?)

A recent seafloor eruption on the East Pacific Rise paved over hydrothermal vents near 9°50'N, destroying the animal communities and providing an exciting opportunity to study how species recolonize after disturbance. We monitored the arrival of species to distinguish between two hypotheses: whether the new pioneers would persist and lead to a different community, or would simply contribute to an early transient stage in a transition back to the pre-eruption fauna.

What have you discovered or learned that you didn't know before you started this work?

We discovered that one dominant pioneer limpet species, *Ctenopelta porifera,* was transient, although present in small numbers even 40 months after the eruption. Another pioneer limpet, *Lepetodrilus tevnianus*, continued as a dominant species. *L. tevnianus* appears to outcompete other species that were abundant before the eruption. The rate of overall community development is slower than after a previous (1991) eruption, and less tightly coupled to chemical changes.

What is the significance of your findings for others working in this field of inquiry and for the broader scientific community?

Our results demonstrate that recolonization of deep-sea vents is subject to the vagaries of larval supply – that is, it depends on which species happen to be present as larvae immediately following a disturbance. The rate and character of community development are not driven solely by physical or chemical characteristics of vent habitat, but are instead influenced by biological processes.

What is the significance of this research for society?

Mining companies plan to extract minerals from deep-sea vents, a process that will disturb both the animal communities and the vent habitat. If such projects are to be done sustainably, and without permanent, regional impacts on the diversity of vent communities, the operators need to base decisions about the location and extent of mining on sound ecological principles. Data such as ours on the larval connections between vents, the predictability of recolonization, and the resilience of communities, are critical input for those decisions.

What were the most unusual or unexpected results and opportunities in this investigation?

We were surprised that one of the dominant pioneers, the limpet *Ctenopelta porifera*, had not been observed after the 1991 eruption at this site. Even more astonishing is the distance that *Ctenopelta porifera* larvae had to disperse to our study site. Before the eruption, the nearest known populations of this species were more than 300 km away.

What were the greatest challenges and difficulties?

When and where was this investigation conducted? (For instance, did you conduct new field research, or was this a new analysis of existing data?)

> The study was conducted at a well-characterized vent field near 10°N on the East Pacific Rise. This area was designated as an Integrated Study Site by the NSF Ridge 2000 program.

What were the key tools or instruments you used to conduct this research?

> The submersibles Alvin (US) and Nautile (France) were used to take samples and make observations. Funds from this award allowed us to participate in a French expedition on the vessel *Atalante* in April 2010, extending our observations a further 2 ½ years beyond NSF-funded cruises.

Is this research part of a larger project or program?

> This project was a collaborative effort with colleague Nadine LeBris from CNRS in France. It benefited from pilot observations initiated during eruption-response cruises funded by the National Science Foundation through the Ridge 2000 program.

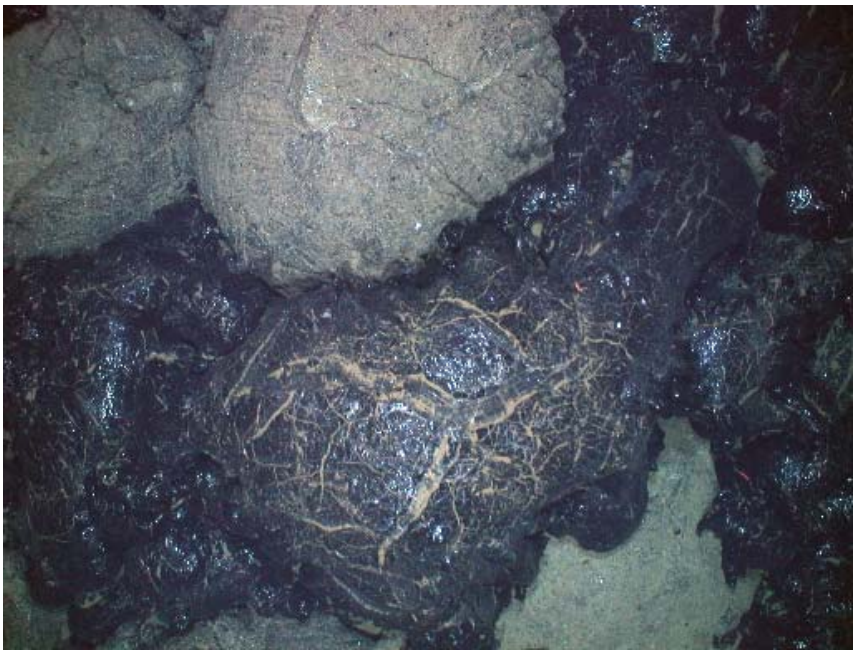
What are your next steps?

> We will continue to monitor the post-eruption vent community to see whether the pioneer limpet *Lepetodrilus tevnianus* persists as the community transitions through succession.

Have you published findings or web pages related to this research? Please provide a citation, reprint, and web link (when available).

> This project has been published in the online journal PLoS ONE:
> http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0050015
>
> Mullineaux LS, Le Bris N, Mills SW, Henri P, Bayer SR, et al. (2012) Detecting the Influence of Initial Pioneers on Succession at Deep-Sea Vents. PLoS ONE 7(12): e50015. doi:10.1371/journal.pone.0050015

Please provide photographs, illustrations, tables/charts, and web links that can help illustrate your research.



Contact between new basalt and old after the 2006 eruption on the East Pacific Rise. Photo credit Fornari, Cowen and TCSNH06 science party.

Map of the East Pacific Rise showing area of eruption near 10°N. Image from Dive and Discover

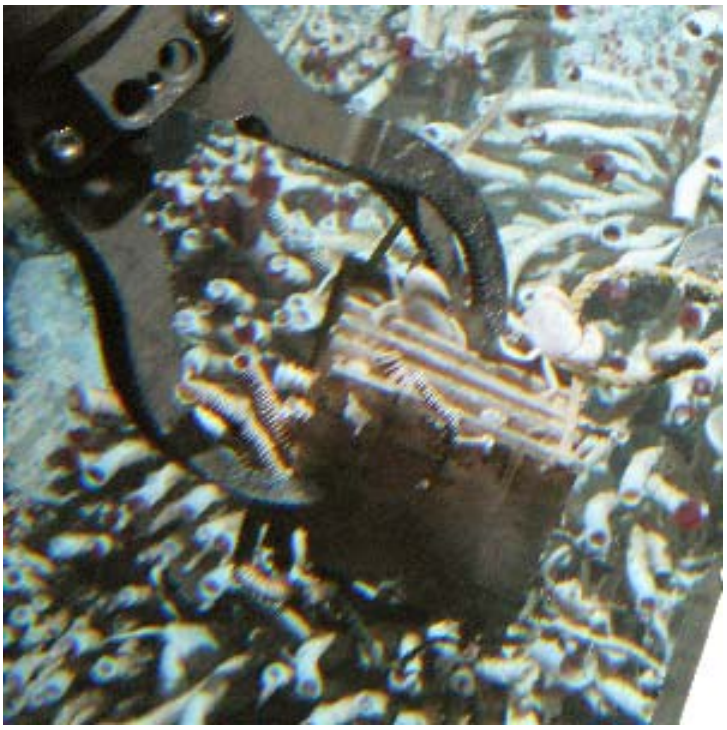
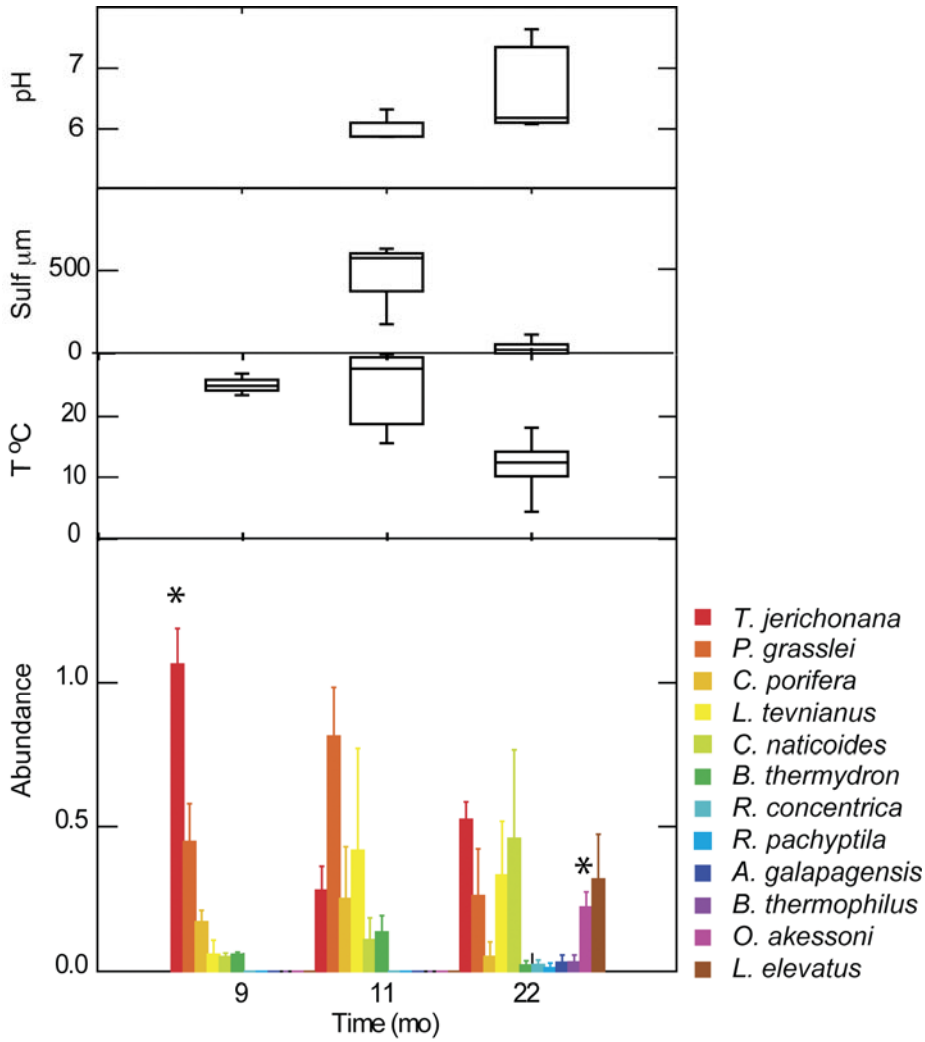


Photo of vent tubeworms and crab on colonization surface recovered with manipulator from submersible Alvin. Photo by WHOI Alvin crew and LADDER science party.



Abundance of species (mean and standard error of transformed data) colonizing P-vent near 9°50'N at 9, 11 and 22 months after the 2006 eruption. Environmental conditions (temperature, sulfide and pH are displayed as box plots, with median (horizontal line), quartile (boxes), and range (vertical bars). Note the persistence of the limpet *Lepetodrilus elevatus* (yellow) over time, while the other pioneer limpet *Ctenopelta porifera* and the ribbed tubeworm *Tevnia jerichonana* decline in relative abundance. Figure from Mullineaux et al. 2012.