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Rebuilding a Vent Community: Lessons from the EPR Integrated Study Site

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HIGHLIGHT | REBUILDING A VENT COMMUNITY: LESSONS FROM THE EAST PACIFIC RISE INTEGRATED STUDY SITE

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The discovery of a seafloor eruption at the East Pacific Rise (EPR) in 1991 presented an opportunity to examine the colonization and assembly of macrofaunal communities at newly formed diffuse-flow vents as well as to document the changes in community composition (Shank et al., 1998) in the context of temperature variation (Scheirer et al., 2006) and fluid chemistry (Von Damm and Lilley, 2004). The eruption site became a focus of the Ridge 2000 EPR Integrated Study Site (ISS) established to facilitate studies of the interaction of biological, geochemical, and/or physical processes associated with seafloor spreading. A second seafloor eruption in 2005–2006 provided opportunities to not only observe changes in community composition and environmental conditions, but also to deploy colonization substrata and other specialized equipment from "time zero." Here we focus on how larval dispersal and recruitment contribute to the establishment of hydrothermal vent communities.

Following the 1991 eruption, the pattern of ecological succession at diffuse-flow vents was generally correlated with decreasing temperatures and concentrations of hydrothermal fluids over time (Shank et al., 1998). At new diffuse-flow hydrothermal vents, the tubeworms *Tevnia jerichonana* were the initial megafaunal settlers, followed by the colonization of the larger tubeworm *Riftia pachyptila*, which dominated most of the diffuse-flow habitats within 2.5 years (Shank et al., 1998). Although differences in the habitat preferences of *T. jerichonana* and *R. pachyptila* (Luther et al., 2012, in this issue) may determine the sequence of colonization, *R. pachyptila* only colonized basalt block deployments (see figure) that were also colonized by *T. jerichonana* (Mullineaux et al., 2000) but not the uninhabited tubes of *T. jerichonana* (Hunt et al., 2004). Together, these studies suggest that a biogenic cue produced by *T. jerichonana* may facilitate recruitment of *R. pachyptila* in the early stages of community development after a seafloor eruption. Once *R. pachyptila* was established as the dominant foundation species, recruitment of additional *R. pachyptila* appeared to occur in pulses throughout the vent field (Thiébaut et al., 2002). Larvae of the mussel *Bathymodiolus thermophilus* settled within and outside of *R. pachyptila* aggregations and became the dominant foundation species more than five years after the eruption. Although mussels were associated with cooler temperatures and lower concentrations of hydrothermal fluids (Luther et al., 2012, in this issue), biotic factors seem to have also contributed to the change from tubeworm to mussels, including changes in larval supply and recruitment. In addition, the shift in community composition may have been due to post-settlement factors, including the redirection of hydrothermal fluids (Johnson et al., 1994, Lutz et al., 2008) and the ingestion of *R. pachyptila* and other invertebrate larvae by adult mussels (Lenihan et al., 2008).

Because larval supply and colonization were being monitored at the EPR ISS prior to the 2005–2006 eruptions, the most recent eruptions provided a natural experiment to investigate the role of larval supply in recolonization of the site. Prior to the 2005–2006 eruptions, gastropods (mostly *Lepetodrilus* species) were the numerically dominant epifauna in aggregations of *R. pachyptila* (Govenar et al., 2005) and *B. thermophilus* (Dreyer et al., 2005) and exhibited gregarious settlement but discontinuous recruitment due to high juvenile mortality resulting from predation by fish (e.g., Sancho et al., 2005). Following the 2005–2006 eruptions, however, two other species—*L. tevnianus* and *Ctenopelta porifera*—became the numerically dominant epifaunal gastropods. The reproductive traits of *L. tevnianus* and *C. porifera* were similar to the previously dominant gastropod species and did not explain the settlement or recruitment of these pioneers (Bayer et al., 2011). Instead, it appears that the supply of larvae had drastically changed. The eruption seems to have removed the local sources of the previously dominant gastropods, enabling colonization by pioneer larvae such as *C. porifera* and *L. tevnianus* from distant sources (Mullineaux et al., 2010). With respect to the megafauna, the patterns of ecological succession following the 2005–2006 eruptions initially appeared to be similar to what was observed after the 1991 eruption, but more than two years later, the tubeworm *T. jerichonana* remained the dominant megafaunal species over *R. pachyptila* at most diffuse-flow vents (Mullineaux et al., 2010). Further monitoring of larval supply concurrent with multidisciplinary investigations of dispersal and colonization at the Ridge 2000 ISS will reveal the specific mechanisms of abiotic factors and biological interactions in the ecological succession of vent communities following seafloor eruptions.

Recovery of basalt block used for succession studies, after deployment for five months (Hunt et al., 2004). *Photo by R.L. Williams, WHOI Alvin group*

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