Distinct chemical microenvironments drive two different macrofaunal habitat types in the East Pacific Rise, 9°50 N hydrothermal ecosystems

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Volcanic eruptions around biomass-rich hydrothermal habitats can lead to the rapid burial of organic carbon, which can later fuel subseafloor life. Yet, still little is known on the habitat evolution within a vent volcanic cycle. The vents at East Pacific Rise (EPR), 9° 50 N hosted a full cycle of macrofaunal succession between two eruptions that occurred in 1991 and 2005. In April 2017, 12 years from the latest eruption, and as a follow-up of our work in the last decade, we conducted research at the site with the submersible *Alvin*. Coupling video-based observations to an in-situ voltammetric sensor probing and ex-situ analyses of habitat fluids, we demonstrate two major habitat types: The first are the relatively mild-temperature habitats where oxygen and sulfide coexist and fuel invertebrate chemosymbiosis. Particularly *Riftia* tubeworms have been extensively observed around Tica and Biovent sites, however the temperatures and sulfide concentrations around these invertebrates were lower than the earlier phase of the volcanic cycle. Mussels started to invade tubeworm habitats, confirming the cooling pattern. In contrast, away from the classic tubeworm habitats the second habitat type emerges. These are mostly in the form of diffuse flow sources, excluding tubeworms and mussel assemblages, only inhabited by high-T tolerant species such as sulfur-oxidizing microbial mats and *Alvinella pompejana*. These types of habitats cluster around the Q and M vent area, where metal-rich suboxic processes dominate. At the same temperature, this second habitat type contains more electron donors such as dissolved metals that consume any oxygen, leading to suboxic conditions and lower temperature-sulfide slopes. Twelve years after the 2005/2006 eruptions, mussels are taking over as predicted only in the areas where chemical dynamics allows coexistence of oxygen and sulfide. The mats in the Q/M area do not conform to such a succession scheme, indicating that those assemblages remain more 'resilient' towards replacement by competitors due primarily to their distinct fluid chemistry.