Patterns of community change of archaeal and bacterial populations colonizing extreme environments at Kilauea Volcano, Hawaii

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Abstract

Volcanic activity creates new landforms that can change dramatically as a consequence of biotic succession, and microbes are essential contributors to successional development. Our objective was to expand our knowledge of the spatial and temporal dynamics of microbial communities in nascent soils. To study primary succession we characterized the microbial diversity on a chronosequence of volcanic deposits ranging from 20 to 300 yr located in the Kilauea Volcano, Hawaii by analysis of *Bacteria* and *Archaea* 16S rRNA gene sequences amplified from total DNA, Community-Level Phospholipids Fatty Acid, Community-Level Physiological Profiles using ECOplate, and bacterial isolates. A parallel investigation of the extent of secondary succession was made on a nearby geothermally active site. *Primary succession.* phylogeny of 16S rRNA gene sequences indicated a high diversity of sequences not related to known taxa with 15 classes within the *Bacteria* domain and a high relative abundance within the *Archaea* domain of various unclassified non-thermophilic *Crenarchaeota*. Bacterial richness and diversity increased significantly with age, while no correlation was found among the archaeal community. The 194 isolates, together encompassing only 1.6% of total culture independent diversity, were not among the dominant clones in the libraries. Carbon utilization profiles and plate counts indicated that heterotrophic communities that are established on older sites were more active and occurred in higher numbers. Multivariate analyses showed not only that the bacterial communities of distinct sites and ecosystem regime shared similar phylotypes, but also revealed a gradual succession of the community structure. *Secondary succession.* elevated soil temperature (up to 87°C), and steam vents provide evidence of an active geothermal system. Bacterial clones and thermophilic *Crenarchaeota* were limited to the geothermal system, and not detected in the surrounding area. This not only indicates that the temperature shift resulted in a change of the community structure of these volcanic deposits, but also that the underlying strata might be the source for hyperthermophiles. In general, microbes are able to colonize and establish a community among recent volcanic deposits. However, environmental parameters rather than site age influence this successional development. This work yields new insights into survival and succession of microbes in soils. ^

Subject Area

Microbiology

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