Diversity and distribution of key subseafloor hyperthermophilic archaea at an active deep-sea volcano

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It has been hypothesized that life may have originated and evolved near deep-sea hydrothermal systems, and that extant organisms living in these likely analogues of early habitats may still harbor metabolic, physiological, and genetic characteristics of early archaean life. The Thermococcales are the most frequently isolated organisms from hydrothermal vents and are of particular relevance in studies of the subseafloor because their isolation from low-temperature hydrothermal vent fluids well below their optimal growth temperature indicates a warm, anaerobic environment within the seafloor. Such microbes unique to the subseafloor could provide insight into metabolic processes, strategies for growth, and survival of life forms in the subsurface of planets and moons with a water history. The purpose of this study was to ascertain if a key group of vent hyperthermophilic archaea, the Thermococcales, shows phylogenetic and physiological characteristics that indicate their adaptation to vent habitats that have markedly different physical and chemical characteristics. Both culture-based and environmental sequence analysis of the 16S rRNA gene and ITS region were used to assess diversity. Results indicate that our culturing efforts are capturing much of the in-situ diversity, and also suggest a link between the Thermococcales genetic diversity and source vent chemistry. Our study shows the importance of combining culture-based and phylogenetic approaches to better understand the ecology of key subseafloor microorganisms such as the Thermococcales. This information will aid in our search for extraterrestrial life particularly in settings with a history of water and volcanic activity.