Comparative analyses of microorganisms from different high-temperature volcanic environments

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Volcanic environments and the microorganisms thriving in these hostile sites are mostly unknown requiring further studies to understand their participation in biological and geochemical cycles. This study presents a comparative analysis of the microorganisms encountered in high temperature environments from two geographically distant volcanic environments, located in Canary Islands (Spain) and Kamchatka Peninsula (Russian Federation).

Since the isolation and characterization of microorganisms living under extreme conditions (i.e., high temperatures) is generally difficult, the use of molecular techniques allows the detection of uncultured microorganisms and so a broader approach to study their distribution and role in these environments. Both high-temperature sites with temperature between 70 and 95°C were sampled in a preliminary study to decipher the microorganisms present in these extreme environments. The 16S rRNA genes were amplified from environmental DNA and RNA. DNA-based detection suggests the presence of a microorganism while RNA-based analysis indicated that a microorganism is metabolically active in the given environment. Among the detected microorganisms the Proteobacteria were the most frequently found bacterial group, and others like Actinobacteria, Firmicutes, Bacteroidetes, and Verrucomicrobia were significant in the studied samples. Interestingly, neither DNA nor RNA analysis lead to the detection of typical hyperthermophilic microorganisms. Bacterial RNA stability at high temperatures was determined and its half-life was around 2-5 minutes. Thus, the presence of mesophiles (or moderate thermophiles) in these high temperature environments might be a result of a high dispersion rate leading to a high number of immigrant microorganisms to these high temperature locations. Consequently, this study has serious implications on current estimates of bacterial diversity, the distribution and dispersal of microorganisms, and a high potential of microbes for colonizing novel environments.

Keywords high temperature; Canary Islands; Kamchatka, thermophiles; mesophiles; bacterial immigration; volcanic environments