Evidence for Local Adaptation in Extremophilic Crenarchaeal Systems: A SSV-Sulfolobus Study

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According to the theory of “local adaptation” in parasite systems, a parasite should “perform better” on its local or “sympatric” host than on a distant or “allopatric” host due to factors, which provide the parasite population with greater genetic diversity compared to host and thus an advantage during coevolution. These factors include: larger population size than host; higher mutation rate than host; greater migration rate than host; and, shorter generation time than host. In a virus-host system, this means that a virus should exhibit higher infection and replication rates in a sympatric host than in an allopatric host.

*Sulfolobus* species are crenarchaeota that survive and thrive in high temperature (65°C-92°C) and low pH (pH < 4) sulfuric hot springs. They are infected by a variety of thermotolerant viruses including the *Sulfolobus*-Spindle Virus (SSV), a non-lytic “lemon-shaped” virus approximately 60 nm x 90 nm in size. SSVs have 14-17kbp circular double-stranded DNA genomes that encode 34-37 open reading frames. Using four sympatric SSV-Sulfolobus pairs, each from biogeographically-distinct geothermal regions (Yellowstone National Park, WY, USA; Lassen Volcanic National Park, CA, USA; Iceland; and, Russia), this study tests whether virus local adaptation is ubiquitous across SSV-Sulfolobus systems.

Measures of relative virus production for a selected SSV strain on multiple allopatric hosts in independent virus-host interaction trials are compared to virus production of the SSV in its sympatric host. Furthermore, virus production for several SSVs that are independently used to infect a single selected host are measured. These data indicate the nature of local adaptation across SSV-Sulfolobus systems and provide insights into the nature of coevolutionary processes in an extreme environment and in a presumably evolutionarily “ancient” virus-host system.