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

Dyana Lucas, Manny Ceballos, and Michael Ceballos

Native American Research Laboratory, Division of Biological Sciences
The University of Montana (Missoula, MT)

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.