Antarctic viromics
Is permafrost thaw in the Antarctic ‘seeding’ water bodies with preserved microbial communities?

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The Antarctic continent is the most physically and chemically extreme environment to be inhabited by microorganisms, where extreme climatic conditions and lack of available liquid water hamper life. Yet it still supports diverse microbial communities including algae. Over the past 5 years a few attempts have been made to explore various viromes, initial reports suggest a high viral abundance in the pristine Antarctic Lakes and a few studies have recently characterised various bacteriophages in the McMurdo Dry Valley soils. Nonetheless, the overall dynamics of virus ecology of the Antarctic remain a total mystery.

The impacts of climate change are evident in the Antarctic, especially in the McMurdo Dry Valleys. Thawing of permafrost is resulting in the destabilization of permafrost lake deposits that have preserved algal mats (cyanobacteria) for thousands to tens of thousands of years. It is currently unknown whether these melting sedimentary deposits are releasing the preserved microbial communities, seeding the streams, ponds, and lakes. The downstream impacts on the microbial ecology of the McMurdo Dry Valley lakes, especially viral dynamics and evolution is also unknown.

To address this question we have decided to use circular single-stranded DNA viruses (ssDNA) recovered from algal mats collected from a permafrost lake (Lake sterilised, frozen since the last ice age in the Garwood Valley, as indicators. We are using metagenomic approaches coupled with conventional techniques to recover full ssDNA viral genomes.

Our hypothesis is that if the streams, ponds and lakes in the dry valleys are being seeded by viable microbial communities, the ssDNA viruses recovered from the permafrost preserved algal mats should be similar to those found in the water bodies, with certain viral species sharing high sequence identity. If not, we would clearly see the marked difference in the ssDNA viral community structure and high sequence diversity.

As part of our pilot work, we have recovered diverse circular ssDNA viruses from Oscillatoriales algal mats sampled from retreating glaciers in the Delta complex in the Garwood Valley and a pond (near Britannia Island campsite) in the McMurdo Dry Valleys.

Additionally in the Antarctic, we are also researching viruses in Adelie penguin fecal samples (more than 30 full viral genome genomes have been recovered) collected at the Cape Royds and Cape Crozier colonies.

References: