

Microbial Inhabitants of Rock Varnish: Visitors or Niche Specialists

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Scientific Question

Newly discovered thin rock layers on Mars containing high concentrations of manganese opens up new possibilities for habitability on that planet. Such materials are reminiscent of rock varnish, which on Earth is a micron-thin, dark layer commonly found on rock surfaces in arid regions and enriched in manganese- and iron-oxides. The formation mechanism of varnish is not well understood; although biotic, abiotic and paired biotic/abiotic formation mechanisms have been proposed. Microorganisms occupy crevices, pores and layers within rock varnish; yet, the relationship between microbes and varnish remains a source of long-standing controversy. Do microbes drive the formation of varnish, oxidizing Mn and Fe to gain energy, do they utilize varnish as a protective habitat, or are they simply visitors blown in on the wind?

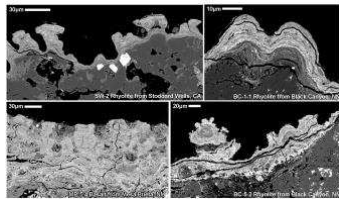


Figure 1: Varnish pinnacles

Results/Discussion

Microscopic analysis of varnish thin sections revealed pinnacles in many varnish samples that could indicate light-dependent growth patterns (Fig. 1). Metagenomic analysis of washed and unwashed varnish samples and surrounding surface soils revealed distinct taxa and metabolic processes associated with the varnish communities (Fig. 2). Sequences representing distinct genus- to species-level taxa, including cyanobacterial members of the *Xenococcaceae*, alpha-proteobacterial *Acetobacteraceae* and actinobacterial *Rubrobacter*, were enriched in varnish samples collected from different geographic sites around the western U.S. and representing different underlying rock mineralogy.

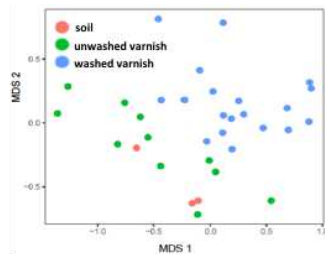


Figure 2: NMDS plot of microbial community composition