FUMAROLES AS LONG-TERM HABITATS FOR PHOTOSYNTHETIC LIFE ON MARS. T. M. McCollom[1], K. L. Rogers[2] and B. M. Hynek[1,3], [1]Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO 80303 (mccollom@lasp.colorado.edu), [2]Rensselaer Polytechnic Institute, Troy, NY, [3]Department of Geological Sciences, University of Colorado.

Introduction: Throughout much of its history, the surface of Mars has been inhospitable to life owing to frigid temperatures and a scarcity of liquid water. Even while such conditions prevail on the global scale, however, volcanic fumaroles can provide local surface environments where liquid water is available and temperatures are elevated above ambient conditions owing to condensation of H_2O-rich volcanic vapors. During our investigation of Cerro Negro volcano, Nicaragua, as an analog system for acid-sulfate alteration of basalt on Mars [1,2], we have observed the widespread presence of photosynthetic endolithic communities hosted within minerals deposited in fumaroles (Fig. 1a). These communites inhabit environments where condensation of steam-rich vapors provide a continuous source of moisture in the otherwise semi-arid climate and elevate temperatures well above ambient conditions. We will report on the physicochemical environments that these communities inhabit, and speculate on the implications of these findings for the habitability of fumarolic environments on Mars.

Geologic setting: Cerro Negro (CN) is a young, basaltic cinder cone that last erupted in 1999. Within the volcano's crater, steam-rich vapors discharge to the surface in two principal modes: (1) a few scattered, localized areas of focused, high temperature (to >200°C) venting of strongly acidic, SO_2-rich steam, and (2) broad areas where diffuse vapor flow occurs through cinders and altered mineral deposits. In the diffuse areas, condensation of vapors leaves a layer of moisture on the rocks and mineral deposits, surface temperatures range from ~100°C down to ambient, and the pH of condensed fluids range from mildly acidic (~4) to circumneutral (~7).

Endolithic communities: The presence of photsynthetic communities within the fumarolic deposits is readily recognizable by layers of green pigmentation (Fig. 1a). The pigment layers are invariably enclosed within minerals, typically 0.5 cm or more below the surface. While temperatures in areas of diffuse vapor discharge can range to ~100°C, the pigmented deposits are confined to areas with T <65°C. Pigmented layers are found at CN in a number of different settings, encompassing a range of mineral substrates (amorphous silica, gypsum, calcite), pH (mildly acidic to circumneutral), and fluid compositions (e.g., high vs. low sulfate concentrations).

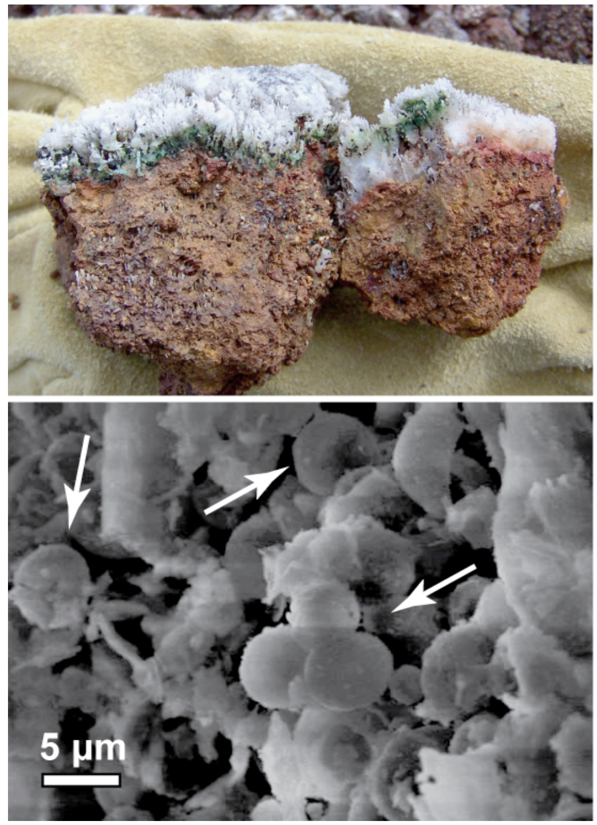

Figure 1. (a) Photosynthetic endolith community embedded in amorphous silica spires deposited on top of altered basalt. (b) SEM image of pigmented layer, with SiO_2-coated spheroids (arrows) that presumably represent encased cyanobacerial cells.

Initial analysis of one endolithic community indicates it is dominated by acidic red algae (*Cyanidiales*), aerobic bacterial heterotrophs (*Ktedonobacteria*), and archaeal thermoacidophiles (*Hyperthermus, Caldisphaera,* and *Thermofilum*) [3]. Examination of the pigmented layers by SEM revealed widespread spherical shapes ~5 μm in diameter that presumably represent photosynthetic cells (Fig. 1b). In some deposits, the spheroids have high Si contents, suggesting the cells may serve as templates for precipitation of SiO_2, allowing the structures to be preserved in the geologic record.

References: [1] McCollom T. M. et al. (2013) *JGR, 118,* 1719-1751. [2] Hynek B. M. et al. (2013) *JGR, 118,* 2083-2104. [3] Rogers K. L. et al. (2014) AGU Fall Meeting, Abstract P32A-02.