

ASSESSING THE ASTROBIOLOGICAL POTENTIAL OF SILICA OCCURRENCES ON MARS.

S. W. Ruff¹, ¹Arizona State University, School of Earth and Space Exploration, Tempe, AZ 85287-6305, steve.ruff@asu.edu.

Introduction: Recent observations from Mars orbiter and rover assets provide unambiguous evidence for opaline silica on the Martian surface [e.g., 1; 2]. Candidate origins include acid-sulfate leaching of basaltic materials via fumarolic steam condensate or perhaps acid fog, and precipitation from geysers and/or hot springs or even cold springs [3]. Terrestrial sites of past or present hydrothermal activity are useful in evaluating Martian silica occurrences and assessing their astrobiological significance. Common examples include sites in Hawaii, Yellowstone National Park, Iceland, and New Zealand. However, their applicability to Mars may be compromised by the abundant meteoric precipitation and moderate to high humidity. Mars likely was never as clement as these places.

The high elevation (4300 m a.s.l.) El Tatio geothermal field in the Atacama Desert of northern Chile has low precipitation, high evaporation, and diurnal freeze-thaw conditions [4] that likely better resemble ancient climatic conditions of Mars. Remarkably, morphologic and spectral features of silica produced in discharge channels from geysers and hot springs at El Tatio have apparent counterparts among the opaline silica outcrops discovered with the Spirit rover in Gusev crater. Here I present some preliminary observations based on ongoing field and laboratory work.

Morphologic Features: Outcrops dominated by opaline silica observed by Spirit were described as having a nodular character with “digitate protrusions” that were assumed to be the result of aeolian erosion [5]. However, silica sinter in some shallow discharge channels of overflowing hot springs at El Tatio have notably similar features that are primary, the result of silica precipitation (Fig 1). Such rocks host microbial communities (dark splotches in bottom Fig. 1) that can become entombed and preserved in silica [e.g., 4; 6]

Spectral Features: Thermal IR spectra from Spirit’s Mini-TES ($\sim 350 - 2000 \text{ cm}^{-1}$) were used to identify the dominant opaline component of the silica outcrops. A deep feature near 1260 cm^{-1} is very weak in terrestrial silica when measured at low emission angles, but was shown to strengthen with increasing emission angle [2; 5]. However, its magnitude even at the highest realistic viewing angles does not match that in key Mini-TES spectra. Some samples from El Tatio have the exceptional characteristic of matching the depth of the Mini-TES feature even at a 0° emission angle (Fig. 2). The cause of this unusual aspect is under investigation.

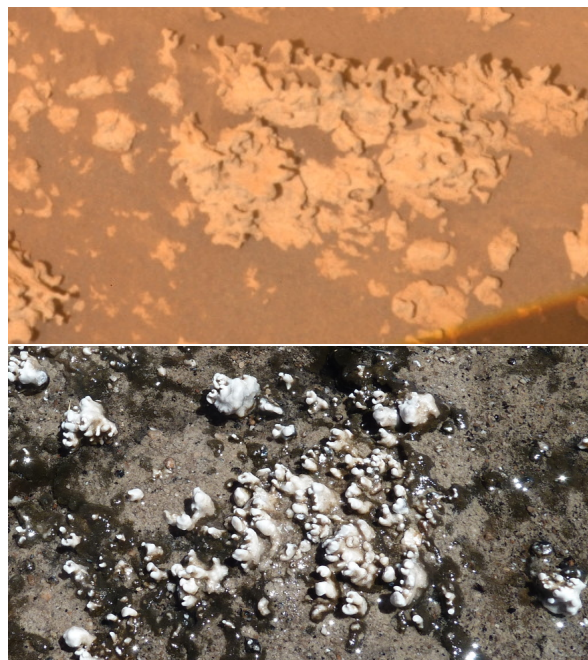


Figure 1. Spirit Pancam image (top) of opaline silica outcrop in Gusev crater compared with columnar opaline silica sinter (bottom) in a shallow hot spring discharge channel at El Tatio, Chile. Scenes $\sim 25 \text{ cm}$ wide.

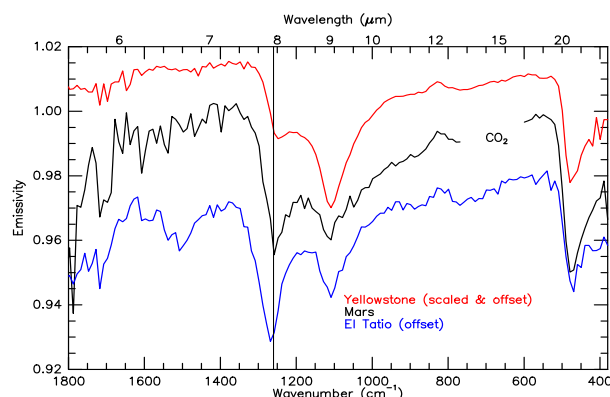


Figure 2. TIR spectra of Earth and Mars silica rocks. Line marks a feature best matched by El Tatio sinter.

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