

SEARCHING FOR EXTANT LIFE ON MARS: WHAT'S NEXT?. B. L. Carrier¹, D. W. Beaty¹, and M. A. Meyer² (conference leads), C. Bakermans³, P. Boston⁴, T. Keift⁵, R. Leveille⁶, R. Mackelprang⁷, T.C. Onstott⁸, R. C. Quinn⁹, A. Schuerger¹⁰, and M. Voytek². ¹Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA. ²NASA Headquarters, Washington, DC, ³Pennsylvania State University, Altoona, PA, ⁴NASA Astrobiology Institute, Mountain View, CA, ⁵New Mexico Tech, Socorro, NM, ⁶McGill University, Montreal, Canada, ⁷Cal State Northridge, Northridge, CA, ⁸Princeton University, Princeton, NJ, ⁹Ames Research Center, Mountain View, CA, ¹⁰University of Florida, Gainesville, FL

Introduction:

From Jan. 29-Feb. 1, 2019 we conducted the conference “Mars Extant Life: What’s Next?” in Carlsbad, NM. The conference attracted approximately 60 abstracts and was implemented by the Lunar and Planetary Institute (with the specific excellence of Debbie Mitchell) and all documentation can be found at the following web site: <https://www.hou.usra.edu/meetings/lifeonmars2019/>.

Purpose and Scope

This three-and-one-half-day conference focused on understanding and discussing strategies for exploring for extant life on Mars. Inspired by the important conference, Biosignature Preservation and Detection in Mars Analog Environments (May 16–18, 2016; Lake Tahoe) that addressed the search for ancient life, this conference promoted broad community discussion of the numerous extant life hypotheses that have been advanced over the years and that have evolved in response to discoveries by on-going Mars missions.

The conference was set-up to provide time for group discussion after each session. In order to allow for deeper penetration into each subject area, and to help set-up for writing the conference report, the conference participants were broken up into smaller groups of ~6-7 people for more in-depth discussion. Each small group was asked to prepare 3-4 viewgraphs on a specific topic to present on the last day of the conference. This was followed up by further discussion amongst the whole group. All of this was then synthesized into the conference report.

Primary Scientific Questions Addressed

The conference program was designed to generate information related to the following major themes:

1. Which candidate environmental niches on Mars are hypothesized to host extant martian life?
2. Which types of measurements are necessary to test these hypotheses?
3. Which kinds of present and future missions, including the associated instrumentation, could contribute to the search for evidence of extant life?

Each key topic was allotted time allocated for discussion in order to identify and establish consensus positions regarding the above questions.

What environmental niches are hypothesized to host extant martian life? Abstracts were sorted into sessions based on different environmental niches including caves, subsurface environments including aquifers and gas pockets, as well as ice and salt based niches. The relevance of atmospheric gases to the search for extant life was also discussed. This breakdown resulted in the formation of five small groups focused on penetrating the following topics: 1) Mars atmospheric gas; 2) Cave environmental niche; 3) Subsurface environment niche; 4) Ice environmental niche; 5) Salt environmental niche.

Which measurements are necessary to test these hypotheses? This question formed the basis of two oral sessions, one focused on possible detection methods and another focused on relevant analogue lab experiments. The corresponding small groups were asked to discuss the options and priorities for methods for detecting life either as we know it, or as we don’t know it; the options and priorities for agnostic life detection techniques; and how terrestrial analogues can be used to prioritize and interpret candidate environments or investigation strategies.

Which kinds of future missions, including the associated instrumentation, could contribute to the search for extant life? The final session on day three was organized around potential search strategies for looking for extant life on Mars. The related small group was asked to examine the options and priorities for methods of detecting life using *in situ* methods and the Mars flight program.

Other related topics. The morning of day four was focused on topics including searching for extant life using possible Mars returned samples, planetary protection implications and other related topics.

Effort was put into documenting the primary conclusions, strategies, and open questions developed at the conference. Our intent is to develop the workshop report into a short publication to be submitted to one of the relevant technical journals, which could be used to convey the essential messages from the conference,

and to allow for a broadening of the key discussion points to scientists who were unable to attend.