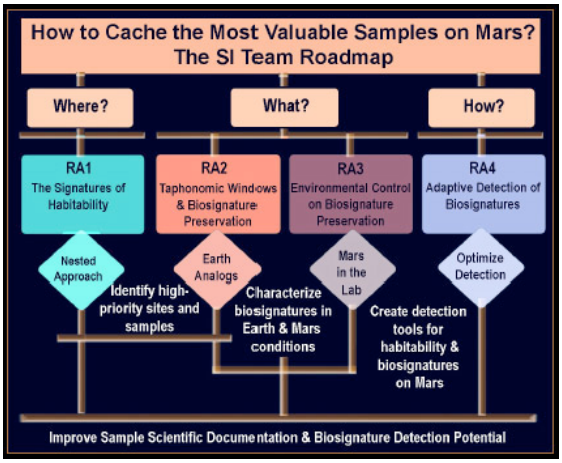
ROADMAP TO BIOSIGNATURE EXPLORATION ON MARS. N. A. Cabrol[1,2], D. Andersen[1], J. Bishop[1], Adrian Brown[1], S. Cady[3], A. Davila[1], E. DeVore[1], G. Ertem[1], J. Farmer[4], E. A. Grin[1], V. Gulick[1,2], N. Hinman[5], J. Moersch[6], V. Parro[7], C. Phillips[1], R. Quinn[1], P. Sobron[1], P. Sarrazin[1], D. Summers[1], D. S. Wettergreen[8], J. Wray[9], K. Zacny[10], D. Blake[2], U. Feister[11], D-P. Häder[12], R. Leveille[13], W. Pollard[13], and R. Arvidson. 1. SETI Institute Carl Sagan Center; 2. NASA Ames; 3. Pacific Northwest National Lab.; 4. Arizona State Univ.; 5. Univ. of Montana; 6. Univ. of Tennessee, Knoxville; 7. INTA-CSIC, CAB, Madrid (Spain); 8. CMU Robotics Institute, Pittsburgh; 9. Georgia Tech., 10. Honeybee Robotics; 11. Lindenberg Meteorological Observatory, Offenbach (Germany); 12. Univ. of Erlangen (Germany); 13. McGill University (Canada); 14. Washington University, St. Louis. Contact Email: Nathalie.A.Cabrol@nasa.gov.

Primary Goal and Science Questions: The SETI Institute (SI) NASA Astrobiology Institute CAN 7 team is developing a roadmap to biosignature exploration in support of NASA's decadal plan for the search for life on Mars [1]. The Mars 2020 mission should provide the first opportunity to investigate the question of past life on Mars with a Curiosity-class rover that will cache samples for return to Earth at a later date [2-4]. Caching samples will be high cost and high risk and will require careful selection. It can be then argued that the simple most critical question to address is: "*How to identify and cache the most valuable samples?"* This question is the focus of our Research Program. How to identify the most valuable samples represents a seemingly daunting challenge because it is multifaceted and each facet contains major uncertainties. One of the main question marks remains the role that the unique early martian environment may have played on habitability, the formation of organic molecules, and the preservation of biosignatures. Understanding how a biogeological record was transformed through the loss of atmosphere, increased biologically-damaging UV radiation, cosmic rays, and chaotically-driven climate changes is, therefore, the key to unlocking *(1) where to search for the right rocks on Mars; (2) what to search for; and (3) how to search*.

Methods: The success of any mission seeking signs of past life on Mars will require progress in addressing these uncertainties and a clearer understanding of Mars *early habitability, its potential for biosignatures, and their preservation potential*. To achieve this, an exploration strategy of correlated and nested measurements of increasing spatial resolution was defined by the Mars 2020 SDT [2]. Likewise, our Research Program brings an integrated exploration approach of ever-increasing resolution that correlates measurements from megascale to molecular scale, and envisions components through the prism of early Mars climate change. The effectiveness of this approach is evaluated in key early Mars analogs in the US, the Arctic, Antarctica, Australia, the Andes, the Chilean Altiplano, and in the lab. Four research areas (RAs) synergistically tackle questions about early Mars habitability, taphonomic windows and biosignature potential, their preservation potential, and their detectability.



Scientifically, we characterize analogs to environments and biogeomaterials considered high-priority in the search for life on early Mars [2] and the impact of changing early martian conditions on the preservation of biosignatures. *Technologically*, we advance the understanding of instrument performance by providing data on threshold and baseline measurements for Mars 2020 high-priority samples. We evaluate their individual and combined diagnostic power on key Mars analog materials. *Methodologically*, we synergistically investigate environments and biogeomaterials at ever-increasing resolution to support, ground-truth, and validate results every step of the way.

Deliverables: Our Research Program will develop a roadmap to biosignature exploration on Mars, including recommendatons for landing site selection and exploration strategies for Mars 2020.

References: National Research Council, *Visions and Voyages,* (2011), p. 142; [2] J. F. Mustard et al., *Report of the Mars 2020 Science Definition Team*, (2013); [3] S. McLennan et al. 2011, E2E-iSAG, (2011); [4] D. W. Beaty et al. 2012, JSWG, MEPAG (2012). **Additional Information:** This Research Program is funded by the NASA Astrobiology Institute under Grant No. NNX15BB01A.