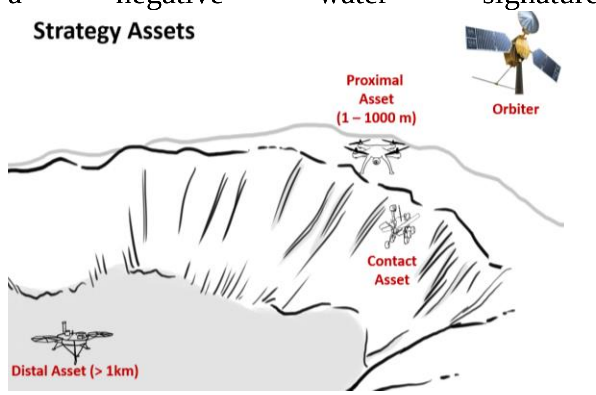
A New Concept Study for Exploring and Sampling Recurring Slope Lineae (RSL) and other Extreme Terrains, L. Kerber[1], R.C. Anderson[1], I. A. D. Nesnas[1], J. W. Burdick[2], F. Calef III[1], G. Meirion-Griffith[1], T. Brown[1], J. Sawoniewicz[1], A. Stefanini[1], M. Paton[1], M. Tanner[2]. [1]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, USA, Engineering and Applied Science, California Institute of Technology, Pasadena, CA 91109, Robert.C.Anderson@jpl.nasa.gov

Introduction: Recurring Slope Lineae, RSL, are terrain discolorations that meet three criteria: 1) they increase in length, 2) they fade, and 3) the periodically recur. They have been observed on some martian crater walls during the warm seasons. Their seasonal behavior and preferential occurrence on warm equator-facing slopes suggest that some volatile, such as liquid brines, may be involved. Since their discovery in 2011, several hypotheses have been proposed to explain this phenomenon. In 2015, signatures of hydrated minerals were detected from the MRO mission imaging spectrometer, providing further evidence that supports the hypothesis of "briny seeps." However, questions remain regarding the mechanism for replenishing the water. Since RSL have only been observed on slopes at the angle of repose of the regolith, others have hypothesized that these features result from dry avalanches possibly triggered by sublimation of frozen CO2 along crater walls. To date, there has been no single hypothesis that can explain all current observations. A JPL study on the Exploration of RSL and gullies took place in June. A consensus has emerged from that study that a mission to explore RSL would have to provide in situ measurements on RSL to be able to disambiguate among the various hypotheses.

Approach and Results: Our first-year effort was split into two phases. The first phase focused on understanding RSL based on orbital imagery, developing a science traceability matrix, and investigate trades for accessing RSL. The second phase focused on advancing rappelling mobility technology by designing and fabricating a tether management system for the Axel rappelling rover. RSL Hypotheses: There are currently three hypotheses for explaining RSL: (1) dry flows [1], (2) volatile-triggered dry flows (either CO2 or H2O triggered) [2], or (3) wet flows either from deliquescence [3], from shallow water sources [4], or from deep underground aquifers. Information about RSL can be gathered from multiple assets (Fig. 1): (i) orbital, (ii) distal (here defined as a near-surface at > 1 km from the RSL source), (iii) proximal (from a 1 km to 1 m), and (iv) contact referring to assets < 1 m to the surface. We examined "what can be learned" from each of the four asset types based on required observations that fall in these three categories: (1) characterization and distribution of RSL, (2) a positive water signature, and (3) a negative water signature.



Without proximal or contact measurements, we are unlikely to be able to disambiguate a negative water signature or identify the water source for a positive signature. Accessing RSL: We examined over 22 possible concepts for accessing RSL, which can be sorted into the following categories: (1) surface ascent (crater floor up), (2) surface descent (crater rim down), (3) aerial (both balloon and rotary winged aircraft), (4) missiles, and (5) tether riders.

References and Publications

[1] F. Schmidt, et al., *Nature Geoscience*, 10:270–273; 2017. [2] C Pilorget and F. Forget, *Nature Geoscience*, 9:65–69; 2015. [3] J. Heinz, et al., *Geophysical Research Letters*, 43:4480–4884; 2016. [4] A. McEwen, et al., *Nature Geoscience*, 7:53; 2013. [5] G. Meirion-Griffith, et al., *Aerospace Conference* 2018. [6] X. Xiong, Ph.D. dissertation, Robotics Institute, CMU, Pittsburgh, PA, September 2015. [7] I. A. Nesnas, J. Matthews, P. Abad-Manterola, J.W. Burdick, et al, *Journal of Field Robotics*, June 2012