DISTINCTIVE BIOPATTERNS FOR DETECTION AND CHARACTERIZATION FROM A ROBOTIC PLATFORM. H. S. Kelly[1], P. J. Boston[1, 2], and A. J. Parness[3]. [1]New Mexico Institute of Mining and Technology, Socorro, NM 87801, [2] National Cave & Karst Research Institute, Carlsbad, NM 88222, [3]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109.

Introduction: Biosignature detection is a key objective for future missions to Mars. Much of the current focus centers around examination of orbital and rover data depicting geomorphological features as harbingers of life [1], verification of existing traces of organic compounds (via spectroscopic and molecular characterization), or lab simulations under Martian conditions [2,3]. We propose an intermediate scale approach using macro-visual inspection at the local scale through the use of a novel exploration robot (Fig. 1) to access challenging terrains. We leverage previous work characterizing many local-scale biosignatures found in Mars-analog environments and this as a basis for sample selection for landed robotic missions before other more costly life detection methods are employed. One such distinctive local-scale biosignature is known as *biovermiculation* (Fig. 2; [4-17]).

Biovermiculations: Biovermiculations (Fig. 2) are microbial mat communities often indurated with a significant amount of biomineral content and trapped exogenous particulates that grow in specific, identifiable patterns putatively to optimize resource accessibility when those resources are limited [18,16]. Under certain sets of conditions, they exhibit geometrically elaborate patterns consisting of lines, circles, and pitted amorphous splotches [19]. These patterns often lithify thus producing characteristic microbial-mineral deposit textures on rock or other surfaces, even after the organisms themselves may no longer be active. Such biopatterns often resemble each other at the macroscopic scale from one environment to another. For instance, a cryptogamic soil in an arid region may have the same spatial partitioning and geometric organization as a biovermiculation coating a cave wall. Therefore, we hypothesize that these selfsame fractal-like patterns may be looked upon as universal biosignatures for life detection even though the details of organism identities, geochemistry, and other conditions may differ markedly. If this claim is valid, then these examples of patterned growth may also be used as indicators of ancient Earth life in preserved geological materials, and potentially a means of life detection in similar environments on other planets [10]. Such biopatterns are arguably prime targets for robotic missions amenable to computerized autonomous pattern analysis as well as being plainly distinguishable to the human eye [16].

Exploration Robot: We are developing an instrument-robot package to test the detectability of biovermiculation patterns in Mars analog environments. This initial proxy suite of robot-mounted instruments will serve as a proof-of-concept that such a macroscopic imaging approach works with real biosignatures in nature. One of the primary technological and operational challenges is to gain access to currently rover-unfriendly sites. Advances in robotic capabilities are being developed at JPL with the LEMUR III rock climbing robotic platform (Fig. 1; [20]) allowing first pass reconnaissance and testing of the detectability of biovermiculations.

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Figure. 1: LEMUR III demonstrates rock-climbing capabilities to better detect biopatterns.

Figure 2: Examples of *biovermculations* in many environments. From Boston et al., unpublished results, 2015.