Mars Commercial-Compatible Initial Human-Precursor Surveying and Instrument-Deployment Concepts

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Water is a critical resource need for future human exploration and habitation of Mars and other planetary environments. An integral scientific question in the search for life outside of Earth is: What are the constraints on life in planetary environments? One of the most critical features of habitable environments is the availability of water - both as an environment for prebiotic chemistry, abiogenesis, and life; and as a vehicle for generating geo- and electro- chemical systems that can support metabolism. Seeking evidence of life prior to human arrival is important both to preserve signs of any existing or past evidence of Martian life, reducing the risks of unintentional forward contamination of Martian environments, and to potentially protect the health of any human crews. Looking forward towards Mars, future human exploration will require a rapid, but thorough, initial survey of any local “area of operations” on Mars to determine the spatial distribution, quantity, and quality (e.g., salt/mineral/organic content) of any local water, as well as to evaluate any signs of current or extinct life. We will discuss several candidate field survey methodologies, involving humans, a teamed instrument platform and a surveying/sampling rover. These are proposed to be validated in a given terrestrial Mars analog environment exhibiting varying distributions of water (ice, permafrost, rock-bound) to evaluate the constraints on life.

Commercial space exploration brings the future possibility of unprecedented mass, power and *in situ* instrument capability, potentially enabling thorough exploration of the geology, hydrology and astrobiology of a km-radius study-zone around a future Mars human/commercial space landing site. We propose to study several representative planetary surface precursor-survey architectures and mission concepts (that are commercial-Mars-compatible), and to test and compare them in field application. We will examine some of the performance issues, using given metrics and controls, of spacesuited humans using handheld and standalone instruments, vs. a robotic human-tended rover/drill, robot arm and instruments. The latter rover-based architecture can in turn be viewed in terms of returned-to-base sample in-situ analyses vs sample analysis performed on a standalone instrument platform deployed away from the primary area of operations.