Major milestone for detecting life on Mars

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Washington, D.C. "To detect life on Mars, we have to devise instruments to recognize it and design them in such a way to get them to the Red Planet most efficiently," said Dr. Andrew Steele of the Carnegie Institution's Geophysical Laboratory, a member of an international team designing devices and techniques to find life on Mars. "We've passed a major milestone. We successfully tested an integrated Mars life-detection strategy for the first time and showed that if life on Mars resembles life on Earth at all, we'll be able to find even a single-cell," he remarked.

Steele is part of the interdisciplinary, international Arctic Mars Analogue Svalbard Expedition (AMASE) team, which is creating a sampling and analysis strategy that could be used for future Mars missions where real-time decision-making on the planet surface will be needed to search for signs of life. Their two-stage strategy involves an initial analysis of the surface to find good target sites and then subsequent collection and analysis protocols to study the samples.

Because its geology is much like Mars, this year's AMASE team just completed a two-week fieldwork expedition in the challenging environment of Bockfjorden on the Norwegian island of Svalbard, which at close to 80o N has the world's northern-most hot springs above sea level.

The AMASE team, led by Dr. Hans Amundsen of Physics of Geological Processes (PGP), University of Oslo, Norway, deployed a suite of life-detection instruments in the frigid Arctic environment, including two spectroscopic instruments deployed by Dr. Pamela Conrad (of JPL and a Carnegie visiting investigator), and Dr. Arthur Lane (of JPL). The instruments are highly sensitive to certain organic and mineralogical markers, or fingerprints, and have the capacity to identify local "hot spots," which are likely to be good targets for finding life. These instruments were tested on hot-spring deposited carbonate terraces containing rock-dwelling (endolithic) bacteria, and within lava conduits on the Sverrefjell volcano. This volcano is currently the nearest terrestrial analogue to the processes that produced features (Carbonate rosettes) that have been found in the Martian meteorite ALH84001.

The Carnegie team led by Dr. Steele, deployed a suite of specially adapted off-the-shelf instruments to rapidly detect and characterize low levels of microbiota. The results of the tests can be used for independent validation, and to cross check among the instruments for greater information than any instrument can yield on its own. Field analysis also allows real-time understanding of the environment, thus permitting the scientists to gather pertinent samples and test hypothesis with minimal sample disturbance. The suite of instruments included standard genetic techniques to identify and characterize bacterial populations (Polymerase Chain Reaction or PCR); a highly sensitive instrument to detect cell wall components (a PTS unit, which was developed by Charles River, and Norm Wainwright of MBL); an instrument to measure cellular activity by analyzing the flux of the energy-storing molecule ATP; and most significantly, protein microarrays.

Protein microarrays are capable of testing for the presence of many hundreds or even thousands of molecules simultaneously. These molecules are not limited to large proteins or cells--smaller molecules i.e., amino acids and nucleotides, the building blocks of life on Earth, can also be found. The Carnegie team has pioneered the use of this technology, principally for life-detection for Mars missions, and has recently been advocating its use in astronaut health and environmental monitoring for long-duration human space flight. "This expedition marks the first time these arrays have been used in the field," commented Dr. Jake Maule of Carnegie, who was responsible for this aspect of the research. Initial results indicate that the team was able to maintain sterile conditions and that the positive results from the protein arrays correlate with PCR, PTS and ATP analysis, as well as the spectroscopic techniques deployed by JPL.

Samples are currently being tested further in the Carnegie labs to verify the field data, and additional expeditions are planned to refine the strategy, technology, and remote operation over the next three years.

The long-term aim of the project is to fully characterize the geology and biology of the Bockfjorden area, to understand the role of biology in the formation and weathering of carbonate deposits that are the only known terrestrial analogue to those found in Martian meteorites. This project will also allow verification of sample acquisition and analysis in simulations at Svalbard, and future missions to Mars and Europa.

Source: Carnegie Institution

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