Carnegie Mellon Rover Heads To Atacama Desert For Final Mission

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Carnegie Mellon University researchers and their colleagues from NASA's Ames Research Center, the universities of Tennessee, Arizona and Iowa, as well as Chilean researchers at Universidad Catolica del Norte (Antofagasta) are preparing for the final stage of a three-year project to develop a prototype robotic astrobiologist, a robot that can explore and study life in the driest desert on Earth.

The team will direct and monitor Zoe, an autonomous solar-powered rover developed at Carnegie Mellon, as it travels 180 kilometers in Chile's Atacama Desert. Zoe is equipped with scientific instruments to seek and identify micro-organisms and to characterize their habitats.

It will use them as it explores three diverse regions of the desert during its two-month stay, which runs from August 22 to October 22.

The results of this expedition ultimately may enable future robots to seek life on Mars, as well as enabling the discovery of new information about the distribution of life on Earth.

The search-for-life project was begun in 2003 under NASA's Astrobiology Science and Technology Program for Exploring Planets, or ASTEP, which concentrates on pushing the limits of technology to study life in harsh environments.

Zoe's abilities represent the culmination of three years of work to determine the optimum design, software and instrumentation for a robot

that can autonomously investigate different habitats.

During the 2004 field season, Zoe exceeded scientists' expectations when it traveled 55 kilometers autonomously and detected living organisms using its onboard Fluorescence Imager (FI) to locate chlorophyll and other organic molecules.

"Our goal with this final investigation is to develop a method to create a real-time, 3D topographic 'map' of life at the microscopic level," said Nathalie Cabrol, a planetary scientist at NASA Ames and the SETI Institute who heads the science investigation aspects of the project.

"This map eventually could be integrated with satellite data to create an unprecedented tool for studies of large-scale environmental activities on life in specific areas. This concept can be applied to planetary research and also on Earth to explore other extreme environments."

"This is the first time a robot is looking for life," said Carnegie Mellon associate research professor David Wettergreen, who leads the project.

"We have worked with rovers and individual instruments before, but Zoe is a complete system for life seeking. We are working toward full autonomy of each day's activities, including scheduling time and resource use, control of instrument deployment and navigation between study areas.

"Last year we learned that the Fluorescence Imager can detect organisms in this environment. This year we'll be able to see how densely an area is populated with organisms and map their distribution. We intend to have the robot make as many as 100 observations and make advances in procedural developments like how to decide where to explore."

Zoe will visit a foggy coastal region, the dry Andean altiplano, and an

area in the desert's arid interior that receives no precipitation for decades at a time.

At these sites, the rover's activities will be guided remotely from an operations center in Pittsburgh where the researchers will characterize the environment, seek clear proof of life and map the distribution of various habitats. During last year's mission, the team carried out experiments using an imager able to detect fluorescence in an area underneath the rover.

The FI detects signals from two fluorescent dyes that mark carbohydrates and proteins - as well as the natural fluorescence of chlorophyll.

The FI, developed by Alan Waggoner, director of the university's Molecular Biosensor and Imaging Center (MBIC), was not fully automated last year. Scientists had to follow the rover and spray dyes onto the sample area. This year, Zoe can spray a mixture of dyes for DNA, protein, lipid and carbohydrates without human intervention.

The Life in the Atacama project is funded with a $3 million, three-year grant from NASA to Carnegie Mellon's Robotics Institute in the School of Computer Science. They collaborate with MBIC scientists, who received a separate $900,000 NASA grant to develop fluorescent dyes and automated microscopes to locate various forms of life.

The science team uses EventScope, a remote experience browser developed by researchers at the STUDIO for Creative Inquiry in Carnegie Mellon's College of Fine Arts, to guide Zoe.

It enables scientists and the public to experience the Atacama environment through the rover's "eyes" and various sensors.

During the field investigation, scientists will interact with Zoe in a science operations control room at the Remote Experience and Learning Lab in Pittsburgh.

Scientists from NASA, the Jet Propulsion Laboratory, the University of Tennessee, University of Arizona, the British Antarctic Survey and the European Space Agency will participate.

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