# Deep Sea Robotics Hold Clues for Space Travel

The Space Systems Laboratory of the Aerospace Engineering Department recently received a $3 million Astrobiology Science and Technology Program (ASTEP) award from NASA.

NASA will use the Clark School's space robotics technology to build a dexterous robot arm for deep submergence activities. This manipulator will be integrated onto the Woods Hole Oceanographic Institute's SEABed autonomous underwater vehicle (AUV), which will be sent under the Arctic ice cap to examine and sample marine life around hydrothermal vents.

Considerable scientific and public interest has been generated by the discovery of deep volcanic vents in the mid-Pacific and mid-Atlantic ocean rifts. The vents, which are caused by drifts in the continental plates far below the ocean, support rich biological environments that thrive based on the chemical energy of nutrients without relying on sunlight.



Recently, volcanic vents were discovered under the ice cap in the Arctic. Technology, however, does not currently exist to sample the life forms around these vents. The Clark School project will be the first to obtain biological samples from the Arctic, which can inform scientists about the similarities and differences of hydrothermal ecosystems in widely separated areas.

David L. Akin, associate professor of aerospace engineering and director of the Space Systems Laboratory (SSL), is the principal investigator for the project, in collaboration with scientists at Woods Hole. Ella Atkins, assistant professor of aerospace engineering, will be integrally involved in the project as well, developing technologies for autonomous perception and planning in order to identify, target and capture specific biological specimens. Four research staff members as well as graduate and undergraduate students are assisting in the project.

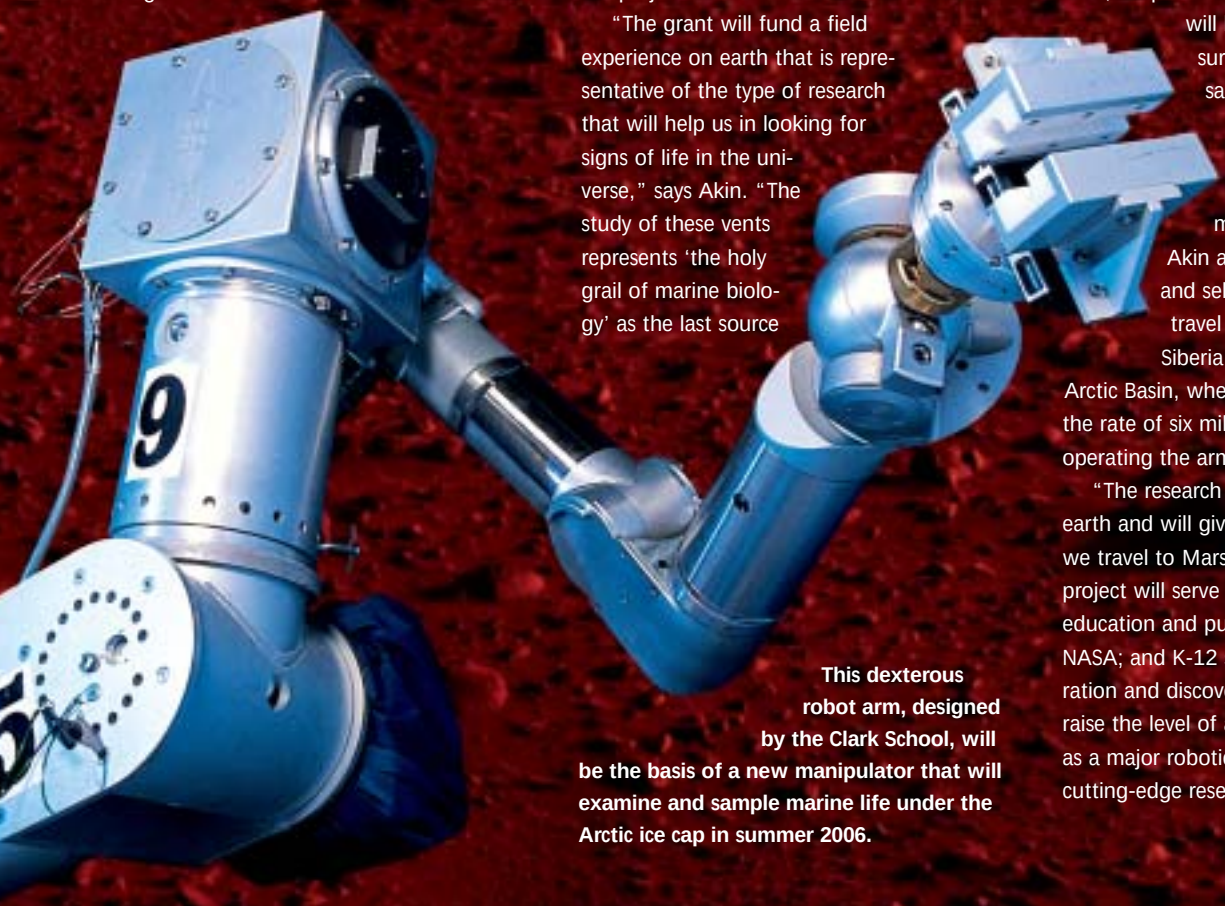
"The grant will fund a field experience on earth that is representative of the type of research that will help us in looking for signs of life in the universe," says Akin. "The study of these vents represents 'the holy grail of marine biology' as the last source of uninvestigated life."

The team will use two different AUVs. APOGEE, an automatic survey robot, will identify the likely places to look for underwater life in the hydrothermal vent. SEABed is the robot that will actually travel to the vents and take photos, but it currently has no way to interact with the local environment. Based on the SSL's experience with underwater robots and highly dexterous robotic technology, SSL will adapt robotic technology to fit on SEABed, which will allow the vehicle to directly sample vent fluids on the sea floor as well as collect samples of vent life such as tubeworms or crabs. The task will mimic sampling in planetary environments such as Mars, Europa and the comets.

The robots will dive to a depth of 5,000 meters with three tons of pressure per square inch. "We are building very thick-walled electronic housing and will fill the inside of the robot arm with oil to maintain pressure equilibrium," explains Akin. "The biggest challenge will be to bring samples to the surface at the same pressure and same temperature as the vent."

The robotic arm will be tested in a tank and in the Atlantic Ocean in the summer of 2005. In summer 2006, Akin anticipates that researchers and select Clark School students will travel to a destination north of Siberia in the ice-covered Eastern Arctic Basin, where the ridges are separating at the rate of six millimeters per year, to test operating the arm of the robot.

"The research will tell us more about life on earth and will give us greater information as we travel to Mars and Europa," he adds. "This project will serve as the center of a number of education and public outreach activities for NASA; and K-12 students can follow the exploration and discovery on the Internet. It also will raise the level of awareness of the Clark School as a major robotics contributor, conducting cutting-edge research in this field." ■



**This dexterous robot arm, designed by the Clark School, will be the basis of a new manipulator that will examine and sample marine life under the Arctic ice cap in summer 2006.**