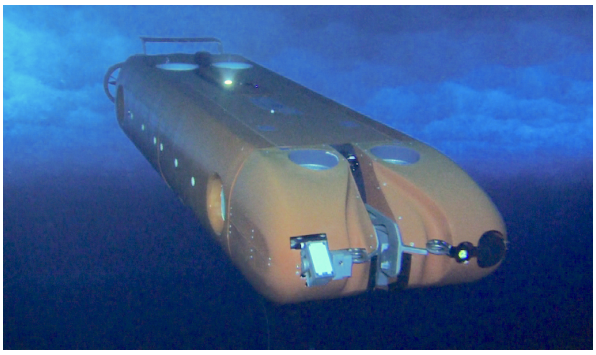
ARTEMIS: DEPLOYMENT OF A LONG-RANGE HOVERING ROBOTIC VEHICLE FOR RICH DATA ACQUISITION AND SAMPLE RETURN BENEATH THE ROSS ICE SHELF. K. Richmond[1], W. C. Stone[1], E. B. Clark[1], C. Flesher[1], L. Lindzey[1,2], J. Harman[1], K. Huffstutler[1], J. Lawrence[3], S. Lelievre[1], J. Moor[1], B. Pease[1], M. Scully[1], V. Siegel[1], L. Winslow[4], D. Blankenship[2], P. Doran[5], S. Kim[6], and B. Schmidt[3], [1]Stone Aerospace, [2]University of Texas Institute for Geophysics, [3]Georgia Institute of Technology, [4]USGS Center for Integrated Data Analytics, [5]Louisiana State University, [6]Moss Landing Marine Labs.

Introduction: ARTEMIS is an autonomous underwater vehicle (AUV) developed by Stone Aerospace as part of the Sub- Ice Marine and PLanetary-analog Ecosystems (SIMPLE) project under the NASA Astrobiology Science and Technology for Exploring Planets (ASTEP) program. The goal of the ARTEMIS vehicle is to provide a platform for both engineering and scientific research to increase our understanding of conditions on and operations for extraterrestrial icy worlds such as Enceledus or Europa by exploring an analog environment on Earth. To this end, in the austral spring of 2015, ARTEMIS carried out biogeochemical and physical studies of the ice-water interface under the McMurdo Ice Shelf (MIS) in Antarctica as part of a multi-phase study. ARTEMIS demonstrated several technologies which represent key advances towards planetary-scale robotic under-ice exploration and the ability to search for life beneath the outer planet icy moons.

Vehicle: The ARTEMIS mission scenario was designed to adhere to several requirements applicable to deployment on extraterrestrial ocean worlds: (1) the ability to reliably conduct operations in completely ice-covered waters accessible only via a single borehole for deployment and recovery, (2) the ability to characterize the physical and geochemical environment, and (3) the ability to search for life at the ice-water interface and conduct detailed investigations (in this case, to take and return water samples) in identified areas of interest. To this end, ARTEMIS carries a diverse sensor suite, including multiple sonar bathymetry systems, an extensive set of *in situ* and flow-through water chemistry sensors, multiple cameras for imagery, a custom ice protein content profiler, and a water sampling system. In addition to long-range cruise capability, the vehicle has the ability to stop, hover, and conduct detailed investigations or intervention operations, including the deployment of a sensor probe arm to contact and characterize the ice ceiling microenvironment. ARTEMIS is deployed through a 10-15 m long borehole in the sea ice next to the ice shelf. Recovery is effected through the same hole. Using only on-board navigation sensors and a single acoustic beacon located at the deployment hole, ARTEMIS finds its way back to the deployment hole and docks to a lighted rod seen by the vehicle's forward cameras.



Deployment: ARTEMIS was deployed to a camp on the sea ice of McMurdo Sound, Antarctica from 25 October – 8 December, 2015. During this period, ARTEMIS performed a total of 20 dives, with a maximum mission length of 10 km. It performed successful tests of all major systems, including deployment, navigation, bathymetric and water checmistry sensing, hovering, ice-probe extension and contact, water sampling, automatic return, and visual docking.