**ARTEMIS: A LONG-RANGE HOVERING ROBOTIC VEHICLE FOR RICH DATA ACQUISITION AND SAMPLE RETURN BENEATH THE ROSS ICE SHELF.** P.W. Kimball[1], W.C.Stone[1], B.P.Hogan[1], K.Richmond[1], C.Flesher[1], V.L.Siegel[1], S. Lelievre[1], E.B.Clark[1], J.Harman[1], K.Huffstutler[1], M.Scully[1], P.Doran[2], M.Skidmore[3], S.Kim[4], B.Schmidt[5], [1]Stone Aerospace – 3511 Caldwell Lane, Del Valle, TX 78617, contact: peter.kimball@stoneaerospace.com; [2]LSU; [3]Montana State University; [4]CalState University; [5]Georgia Institute of technology.

**Introduction:** ARTEMIS is a long-range, hover-capable hybrid autonomous underwater robotic vehicle designed to explore and characterize the environment beneath the Ross Ice Shelf. ARTEMIS is being built by Stone Aerospace as part of the NASA ASTEP-funded Sub-Ice Marine and Planetary analog Ecosystems (SIMPLE) project. The vehicle will be deployed during the 2015 – 2016 Antarctic field season. The vehicle has a nominal mission range of 20 km with energy budgeted for vertical profiles of the water column and close-proximity operations at the ice-water interface.

**Traditional Sensing:** ARTEMIS carries a suite of traditional oceanographic sensors. It is able to create large-area three-dimensional maps of the ice ceiling using an upward-looking multibeam. It carries a second multi-beam sonar on a forward-looking tilt mechanism for obstacle avoidance and additional mapping capability. It carries four high-definition video cameras and LED lighting for each. It carries up- and down-looking acoustic Doppler current profilers, and a conductivity, temperature, and depth sensor (CTD).

**Unique Capabilities:** ARTEMIS features a number of capabilities unique amongst underwater vehicles of its size and range that make it particularly suited to sub-ice biology & environment characterization:

*Through-ice deployment and recovery.* ARTEMIS will be depoyed and recovered through a 1.22m diameter hole in the sea ice. This allows the vehicle to be deployed and recovered from the edge of the Ross Ice Shelf, and thus spend nearly its entire mission endurance beneath the shelf. To achieve this, ARTEMIS features an advanced return and docking system as well as a pumped variable mass center system.

*Science instrument tower.* In order to investigate the ice-water interface, ARTEMIS carries relevant science instruments in a package that can be extended upward 0.8 m from the main body of the vehicle. This allows those sensors to make physical contact with the ice ceiling, but keeps the rest of the vehicle (including e.g. disturbances from control thrusters) away from the measurement site. Instruments on the science tower include dissolved organic matter (DOM), chlorophyll-a, and turbidity sensors, as well as a high-resolution camera, a water inlet port for CTD and pH sensors, and a unique protein fluorescence spectrometer (PFS) to test for microbiological communities within and on the ice.

*Water sample collection.* The inlet for a water sample collection system sits atop the science tower adjacent to the sensors named above. The system pumps water samples down from the top of the tower into a 30-sample storage array contained within the main vehicle.

*Vertical water column profiling.* By extending the science tower away from the vehicle, and using its vertical thrusters, ARTEMIS is able to ascend through the water column with undisturbed flow impinging on the main science sensors. By doing so, ARTEMIS can mimic a traditional ship-based CTD cast.

*Hybrid operation.* ARTEMIS may optionally trail a 15km data fiber. This configuration provides high-bandwidth communications to operators at the surface, allowing teleoperation of ARTEMIS directly, in reaction to live data from the vehicle. Alternatively, ARTEMIS may function entirely autonomously (with no trailing data fiber) according to a list of mission/science objectives. In this configuration, ARTEMIS has increased range, but must rely on its navigation and docking systems to return autonomously to the deployment hole. Fully autonomous operation is a critical fallback in the event of unexpected fiber loss, and also represents an important step toward extraterrestrial deployment of sub-ice astrobiology vehicles like ARTEMIS.

*Through-ice Communications.* ARTEMIS trails a long RF antenna that, when in contact with the ice ceiling, enables low-bandwidth, through-ice communications at ranges up to 10 km from a surface antenna. ARTEMIS also carries a magnetic beacon which can be used for through-ice localization of the vehicle by surface personnel carrying loop antennae.

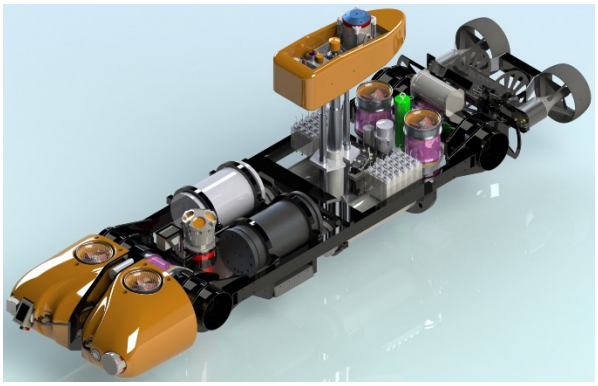

Figure: ARTEMIS vehicle minus flotation foam showing Sonde tower extended for ice proxops studies.