**DEVELOPMENT OF A NEW CLASS OF AUTONOMOUS UNDERWATER VEHICLE (AUV), *ORPHEUS*, FOR THE EXPLORATION OF OCEAN WORLD ANALOGUES.** T. M. Shank[1], C. Machado[1], C. German[1], A. Bowen[1], J. Leighty[2], A. Kelsh[2], R. Smith[2], and K. Hand, [1]Woods Hole Oceanographic Institution, Woods Hole, MA 02543 (tshank@whoi.edu, cmachado@whoi.edu, cgerman@whoi.edu, abowen@whoi.edu), [2]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91125 (John.M.Leichty@jpl.nasa.gov, Andrew.T.Klesh@jpl.nasa.gov, Russell.G.Smith@jpl.nasa.gov, Kevin.P.Hand@jpl.nasa.gov)

Recent developments in the design, construction, and field testing of a new class of Autonomous Underwater Vehicle (*Orpheus*) have been conducted to address fundamental questions about how life has adapted to exist on Earth, via exploration and research in the hadal zone, from 6,000 to 11,000 meters (the deepest habitat on Earth). Recent comparative studies show that the hadal zone hosts microbial and faunal species distinct from species in the rest of the ocean, that the heterogeneity of these habitats are providing settings where environmental conditions (hydrostatic pressure and food supply) markedly differ from the rest of Earth and are now hypothesized to result in high levels of diversity and endemism. All known Ocean Worlds in our solar system (except Earth) host their liquid water oceans beneath a thick ice crust, and the ocean of Europa hydrostatic pressures only found in the depths of Earth's hadal zone (e.g., trenches and troughs). The development of autonomous vehicles is being pursued to explore and research the ecological complexities of Earth's hadal region to address current questions in Earth science as well to utilize Earth's ocean as an analog environment for the exploration of Ocean Worlds.

*Orpheus* is the first in a new class of autonomous underwater vehicles (AUVs) designed to withstand the pressure of the ocean's greatest depths while working independently or as a networked "swarm" to survey and sample almost anywhere in the global ocean. The lightweight design of *Orpheus* is modular and based on proven technology to minimize construction and shipping costs and to also permit it to be launched from small research vessels as well as ships of opportunity. In addition, it incorporates control and mapping software developed by NASA that vastly improves performance obtained with conventional AUV technology and also reconfigure its objectives on-the-fly. Four fixed-directional thrusters and a compact shape make it nimble and controllable, permitting the vehicle to maneuver around obstacles and to land on the seafloor to collect samples and lift off again to continue its mission.

The Hadal Exploration Program (HADEX), aimed at determining the composition and distribution of hadal species, the role of pressure, food supply, physiology, depth, and topography on deep-ocean communities and evolution of life. In addition, a primary goal of the HADEX Program is to develop an armada of new full-ocean depth autonomous underwater vehicles that will not only revolutionize access to the currently inaccessible environments on Earth, but (1) expose the existence, constraints, and limits of life and its evolution on earth; (2) enable comparative investigations of hadal and abyssal life forms throughout the global network of hadal environments on Earth; and (3) serve as the key platform and delivery vehicle for developing and testing key sensors for the detection of habitability and bio-signatures of life (and encouraging partnerships between NASA and oceanograghers). Our program has ushered a new partnership between the Woods Hole Oceanographic Institution and NASA's Jet Propulsion Laboratory to advance the exploration and detection of life in oceans known to exist in our solar system, already bringing together leaders in ocean and space exploration to harness convergent technologies and methodologies that will benefit deep-ocean exploration. The development of advanced robotic technology will allow the pursuit of foremost questions in hadal research as well as all parts of the ocean, from the ice-covered poles to the (analogs that are) deepest trenches.