

## Plenary Talk

# “Exploring the Deep Sea with Robots”

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### Abstract:

In the past two decades, robots have been used in the deep ocean to study basic processes at deep-ocean sites of scientific interest, such as the Mid Ocean Ridge, coral habitats, volcanoes, and the deepest trenches. In this talk, the basic types of robotic vehicle systems we have used will be reviewed, including towed vehicles, remotely operated vehicles (ROVs), and autonomous vehicles (AUVs). Their underlying technologies will also be reviewed, including navigation and control systems, mapping sensors, and *in-situ* sensors. The talk will present results from the first autonomous vehicle surveys of the Mid-Ocean Ridge, our use of autonomous vehicles to make the first discoveries of hydrothermal vents on the Southern Mid-Atlantic and Southwest Indian Ridges, and our recent surveys of unique asphalt volcanoes off the coast of Southern California and the Galapagos Rift Spreading Center. In June 2010, we used the Sentry autonomous underwater vehicle and the TETHYS *in-situ* mass spectrometer to map a deep hydrocarbon plume emerging from the Deepwater Horizon blowout in the Gulf of Mexico. Those results will be presented and the unique aspects of the operational setting will also be discussed. Finally field results from our Nereus vehicle, which reached the bottom of the Challenger Deep in 2009, will be discussed. The talk will conclude with speculation about how these systems will evolve in the future.

### Short Bio:

Dr. Dana Yoerger is a Senior Scientist at the Woods Hole Oceanographic Institution and a leading researcher in robotics and unmanned vehicles. He supervises the research and academic program of graduate students studying oceanographic engineering through the MIT/WHOI Joint Program in the areas of control, robotics, and design. Dr. Yoerger has gone to sea on over 60 oceanographic expeditions, including the 1985 expedition that discovered the Titanic. Dr. Yoerger has been a key contributor to the remotely-operated vehicle JASON; to the Autonomous Benthic Explorer known as ABE; most recently, to the autonomous underwater vehicle, SENTRY; and the hybrid remotely operated vehicle, NEREUS. Recently lost at 3000m depth in the Chile Triple Junction, ABE made over 220 deep ocean dives and deepened our understanding of the Mid-Ocean Ridge, forging the way for the current generation of deep sea mapping AUVs. The AUV SENTRY has expanded the speed, depth capability, and length of deployment beyond ABE. NEREUS, which recently reached the Challenger Deep, includes innovative new technologies for power management, lighting, and buoyancy, as well as a unique hybrid mode: It can swim freely as an AUV to survey and map large areas of the seafloor. Nereus can also be transformed into an ROV with high bandwidth telemetry through a fiber-optic microcable, enabling close-up inspection and precise sampling. Dr. Yoerger was the 2009 recipient of the Lockheed Award for Ocean Science and Engineering.