

Upgraded Alvin Sub Heads for West Coast

On 25 May 2013, the R/V *Atlantis* will leave Woods Hole carrying the upgraded submersible *Alvin*, marking a major milestone in the sub's USD41 million redesign. Both ship and sub are owned by the U.S. Navy and operated by the Woods Hole Oceanographic Institution (WHOI) for the benefit of the entire U.S. ocean science community. They are expected to reach Astoria, Oregon, on 20 June 2013.

In September 2013, *Alvin* will undergo the Navy certification process, making a series of progressively deeper dives off Monterey, California, USA. Once certified, the sub will be put through its paces in a science verification cruise in November 2013 to ensure all of its scientific systems are operational. *Alvin* is scheduled to return to service in December 2013.

Funded by the National Science Foundation (NSF) and WHOI, the planning process for the sub's upgrade began over a decade ago. In 2005, work was begun by Southwest Research Institute to design and forge a new titanium personnel sphere, one of the biggest technical challenges in the *Alvin* upgrade project.

Descending to 6,500m

The sphere, which holds a pilot and two scientists, is designed to descend to 6,500 metres (21,000 feet or 4 miles) – depths that generate nearly 10,000 pounds per square inch (psi) of pressure on the sphere. Construction of the sphere, which has 3-inch-thick walls, required more than 40,000 pounds of titanium. Identical hemispheres were forged and then welded together with an electron beam. Its interior diameter is 4.6 inches wider than *Alvin*'s previous sphere, increasing the interior volume from 144 to 171 cubic feet. With five viewports, it also has improved and overlapping fields of view for the pilot and scientists allowing for better observations and collaboration in selecting sampling sites.

The personnel sphere underwent hydrostatic pressure testing in June 2012, and was successfully tested to the equivalent of 8,000 metres water depth.

Although the new sphere is rated to depths of 6,500 metres, the sub's dives will be limited to 4,500 metres until a second phase of the upgrade can be completed. Phase two hinges on the development of improved lithium ion battery technology and funding.

Improvements made to the submersible during the Phase one upgrade include:

- A new, larger personnel sphere with an ergonomic interior designed to improve comfort on long dives
- Five viewports (instead of the current three) to improve visibility and provide overlapping fields of view for the pilot and two observers
- New lighting and high-definition imaging systems
- New syntactic foam providing buoyancy
- Improved command and control system

Additional improvements were needed to the R/V *Atlantis* to accommodate the larger, heavier sub. Among the ship's upgrades were a strengthened A-frame, which is used to launch and recover the sub, and alterations of the hangar where the sub is stored when not in use.

Important deep-sea discoveries

The world's longest-operating deep-sea submersible, *Alvin* was first launched in 1964. It has made 4,664 dives and played a role in a number of important deep-sea discoveries. Its most famous exploits include locating a lost hydrogen bomb in the Mediterranean Sea in 1966, exploring the first known hydrothermal vent sites in the 1970s, and surveying the wreck of RMS *Titanic* in 1986. Its final series of dives before the current upgrade period were in the Gulf of Mexico exploring deep-sea biological communities near the site of the Deepwater Horizon blowout and oil spill.

Image: Upgraded HOV Alvin was loaded onto R/V Atlantis at the WHOI dock on 13 May 2013. (Image courtesy: Tom Kleindinst, Woods Hole Oceanographic Institution).