Underwater Intervention 2004

Return to the U-166:
Working Together to Meet the Challenge of Deepwater Archaeology

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To meet the challenge of scientifically investigating a deepwater shipwreck, a research team made up of industry, academic, private, and government members came together in October 2003 for a second expedition to the German U-boat, *U-166*. The group consisted of marine archaeologists, microbiologists, oceanographers, surveyors, film makers, ROV operators, and consultants. The *U-166* site lies in 1400 meters of water in the Mississippi Canyon Area of the Gulf of Mexico. The unique historical find was discovered in 2001 during a pipeline survey conducted by C & C Technologies, Inc. for BP Exploration and Production, Inc. and Shell International Exploration, Inc. NOAA's office of Ocean Exploration (OE) facilitated the new expedition, which combined the use of technology common to the oil and gas industry with archaeological mapping techniques and microbiology science.

HISTORICAL BACKGROUND

Twenty-four German U-boats operated in the Gulf of Mexico during World War II. In approximately one year's time, they sank 56 merchant vessels with only one U-boat lost, *U-166* (Figure 1). The *U-166*, under the command of Oberleutnant Hans-Günther Kuhlmann, entered the Gulf in July of 1942 and began her secret mission of laying mines near the mouth of the Mississippi River. Having completed that task by July 25, Kuhlmann positioned *U-166* along the shipping lanes to conduct warfare on merchant shipping.[1] On July 30th the passenger freighter *Robert E. Lee* and her naval escort *PC-566* were transiting across the Gulf en route to New Orleans, LA. At approximately 4:30 in the afternoon the *Robert E. Lee* came into the sights of *U-166*. Almost without warning a torpedo struck the starboard side of the freighter. As she began to sink *PC-566* rushed in and began depth charging the U-boat.[2] The naval Patrol Craft was successful in sinking the *U-166* that July afternoon. The credit for sinking *U-166*, however, was given to a U.S. Cost Guard seaplane, which actually boomed a different U-boat, U-171, two days later and 140 miles farther to the west. The true account of what happened to *U-166* would not be discovered for nearly fifty-nine years.[3]

Figure 1. Photo of the *U-166.*
Courtesy of the Kuhlmann collection, PAST Foundation, and the National D-Day Museum.

OFFSHORE OIL AND GAS SURVEYS

As the oil and gas industry began to turn their interests toward the deep water areas of the Gulf of Mexico, occasionally offshore surveys resulted in incidental discoveries of several of those World War II casualties. In 1986, Shell Offshore, Inc. hired John E. Chance and Associates to conduct a survey in the Mississippi Canyon Area in the Gulf of Mexico using a deep-tow system. While performing the survey they detected two shipwrecks lying in approximately 5000 feet of water. The only shipwrecks the U.S. Department of the Interior, Minerals Management Services (MMS) listed in the vicinity were two World War II casualties, the passenger freighter *Robert E. Lee* and the cargo freighter *Alcoa Puritan.*[4] No further investigation of the shipwrecks were conducted because of the expense and time involved in conducting deepwater surveys with a towed system. The vessel thought to be the *Alcoa Puritan* during the 1986 survey, however, was the German U-boat, *U-166*. The true identity of the vessel was not discovered until additional survey work was conducted in 2001 with new survey technology and under stricter cultural resource guidelines by the MMS.

MMS REGULATORY COMMITMENT

As the Federal agency that administers mineral development on the Outer Continental Shelf (OCS), the MMS must ensure that all activities it permits take into consideration the potential effects these activities may have on archaeological resources. This requirement is mandated through several laws, including the OCS Lands Act, the National Historic Preservation Act, Executive Order 11593, and the National Environmental Policy Act. MMS manages these resources through a

combination of efforts that include funding baseline studies to identify known and expected locations of sites and requiring remote sensing surveys and archaeological assessments in lease blocks that have been determined to have a high potential for containing archaeological resources.

Technology, combined with baseline studies and the MMS database of known sites, governs the archaeological survey requirements for each lease block in the Gulf of Mexico Region. The current model for historic shipwrecks takes into consideration known and reported wreck locations, as well as the reliability of reported locations.

Guidelines for fulfilling MMS's archaeological requirements are published and revised periodically through Notices to Lessees (NTLs). Since the formation of MMS in 1982, there have been about a dozen NTLs and other guidance documents issued. The current archaeological survey requirements have been in effect since March 15, 2002 (NTL 2002-G01). In 1986, at the time of the initial discovery of the *Robert E. Lee* and the *U-166*, which was then incorrectly identified as the *Alcoa Puritan*, the lease block within which these vessels were found did not require an archaeological assessment. In fact, until 1992 there were no archaeological survey requirements for any lease blocks in water depths greater than 200 feet. This was due to several factors, including the relative lack of development in deepwater, the prohibitive costs of conducting surveys in deepwater, and the lack of available information on historic shipwrecks in deepwater. A shallow hazards survey and assessment however, which typically requires a remote sensing survey array similar to that for archaeological resources, was required. It was this shallow hazards survey that initially found the two targets that were later identified as the *Robert E. Lee* and the *U-166.*

Since passage of the Deepwater Royalty Relief Act in 1995, industry has increasingly moved into deeper waters (greater than 1000 feet) of the Gulf of Mexico. In order to keep pace with the increase in deepwater development, new studies have been conducted, and revised regulations have been implemented that now require archaeological surveys and assessments in designated lease blocks throughout the Gulf of Mexico, regardless of water depth. MMS is in the process of completing a new study to revise the model used to determine where historic shipwrecks might be expected. To date we have identified at least 35 historic shipwrecks in water depths greater than 1000 feet.[5] Of these 35 wrecks, 18 have been located, mostly through the results of Right-of-Way shallow hazards pipeline surveys.

2001 *HUGIN 3000* AUV SURVEY

In January 2001, C & C Technologies conducted a deepwater pipeline survey for BP and Shell using C & C's *HUGIN 3000* AUV (High Precision Untethered Geosurvey and Inspection System, Autonomous Underwater Vehicle) (Figure 2). The survey passed near the *Robert E. Lee* and "reported" *Alcoa Puritan.*

After C & C's archaeologists reviewed the AUV survey data, they suspected the target originally thought to be the freighter *Alcoa Puritan*, might actually be the long sought after German U-boat, *U-166*. Additional historical research and AUV surveys helped add strength to the archaeologist's theory. Shell and BP sponsored an ROV investigation of the site to confirm the findings.

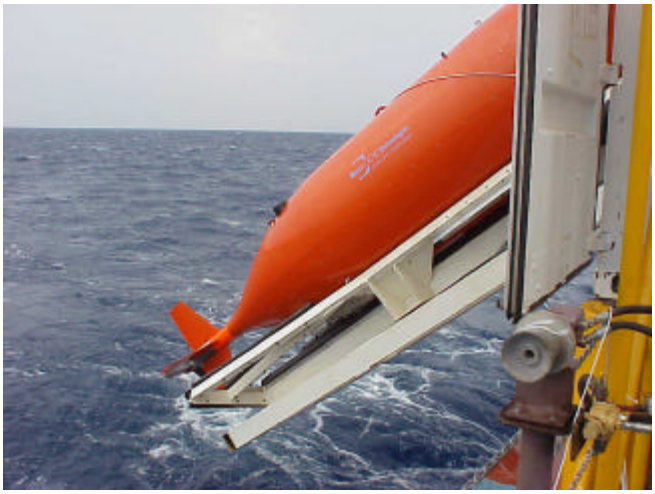

Figure 2. *HUGIN 3000* AUV
The *HUGIN 3000* AUV is capable of surveying to 3000 meters water depth. It operates at approximately 4 knots with greater mobility and accuracy than conventional towed arrays. Operating in 1400 meters of water the *HUGIN 3000*'s positional accuracy is approximately 3 meters after post processing. The AUV utilizes a state-of-the-art multibeam bathymetry system, a dual frequency chirp side scan sonar, chirp sub-bottom profiler, a inertial navigation system coupled with the HiPAP (High Precision Acoustic Positioning) acoustic tracking system.

ROV INVESTIGATION

On May 31, 2001 C & C's archaeologists Robert Church and Daniel Warren along with archaeologists Jack Irion and Richard Anuskiewicz of the MMS joined representatives of BP and Shell to conduct an ROV investigation of the *Robert E. Lee* and the suspected site of the *U-166*. The research team left onboard the *Gary Chouest*, which was equipped with Oceaneering's Millennium VI ROV.

The 2001 *U-166* expedition accomplished the goal of identifying the wreck, but producing a suitable archaeological site map was not possible because of the limited time on site and lack of acoustic positioning for the ROV. Although merely identifying a shipwreck falls well short of archaeological documentation, the AUV and ROV investigations sponsored by BP and Shell provided a good start toward planning an archaeological survey to systematically map the site. After studying the site for approximately two years, C & C Technologies sought support from NOAA Office of Ocean Exploration to conduct a second expedition to the *U-166*.

NOAA OFFICE OF OCEAN EXPLORATION

NOAA Office of Ocean Exploration (OE) was created out of *The Report of the President's Panel on Ocean Exploration*,[6] a document tasking a lead agency to innovatively explore and map the ocean, and to reach out to the community with new discoveries and achievements. OE strives to accomplish many aspects of exploration, and one of them is to systematically explore our nation's maritime heritage by investigating the potential for undiscovered submerged cultural resources, and supporting programs that seek to better understand our maritime past. This is best achieved through collaborative projects that examine new maritime heritage resources, and innovatively share that knowledge to the community

Through OE's annual Announcement of Opportunities, C & C Technologies was awarded a grant to systematically explore the wreck of the *U-166*. OE seeks to apply a multidisciplinary approach to all shipwreck and historical based surveys, and this project offered no exception. In addition to being a grant giving office, OE has the unique ability to also help coordinate these scientific expeditions by allocating dedicated ship time and other scientific marine resources. In the case of this award, it was OE's responsibility to provide the science party with an adequate research vessel and ROV unit in order to accomplish their proposed tasks.

It was decided that the NOAA Ship *Ronald H. Brown* would be used for this project (Figure 3). The class-one research vessel was already being utilized consecutively on three additional OE-sponsored expeditions in the Gulf of Mexico, and the *U-166* Project rounded out the fieldwork. The *U-166* project was the only maritime archaeology cruise, while the other expeditions focused on marine biological communities. By coordinating these cruises in tandem on one vessel (and in some cases combining projects on the same research leg), OE was able to maximize ship time while minimizing mobilization and demobilization expenses.

Figure 3. NOAA Ship *Ronald H. Brown*

All four expeditions utilized the Sonsub ROV, *Innovator*, (Figure 4) representing an excellent example of the science community and industry teaming up to conduct delicate, systematic scientific research. Like the *U-166* cruise, the other three OE-sponsored expeditions benefited greatly from the professional and well-organized operation of the Sonsub crew. Tim Jaramillo was Sonsub's ROV project supervisor for the four expeditions with Ray Maza as the shift supervisor. Greg Wardwell, Lucas Cribley, Maurice Rivard, and Keith Hyatt comprised the remainder of the ROV crew.


Figure 4. Sonsub's *Innovator* ROV

Regardless of the project, OE will personally collaborate with any science party when the opportunity or invitation arises, and intends to always have a NOAA maritime archaeologist on staff to offer assistance and expertise. In the case of the *U-166* expedition, two individuals were made available: John McDonough, OE's Director of Operations, and LTJG Jeremy Weirich, OE's Maritime Archaeological Program Officer. McDonough was on hand to evaluate the unique ROV operations for use on future OE expeditions, while Weirich provided archaeological assistance and cruise coordination between the science party and the ship. Both individuals offered data management support, and assisted with scientific operations.

2003 U-166 PROJECT

The *U-166* Project had three main components: archaeology, biology, and educational outreach. Principal investigator Daniel Warren, along with co-principal investigator Robert Church, directed the archeology as well as shared the overall management responsibilities for the project. MMS archaeologist David Ball and *U-166* consultant Charles J. Christ were onboard to assist the project. Mr. Ball also oversaw regulatory aspects of the projects along with the NOAA OE members. The project was designed to be a non-disturbance expedition. The primary archaeological objectives were to determine the full extent of the site, photo-mosaic the main sections of the wreck, and record the positions and photograph all visible artifacts on the seafloor within the site boundaries.

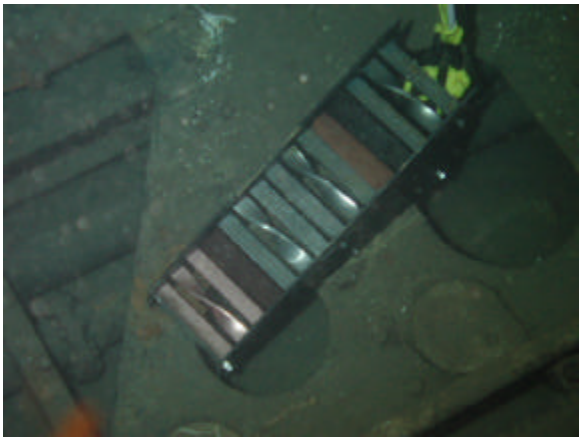

Figure 5. BART Test Platform set at the *U-166* site.

Microbiologist Lori Johnston of Droycon Bioconcepts, Inc., directed the biological aspects of the project. The microbiological objectives were to examine the types of bacteria communities or consortia present. This was accomplished using a series of short and long-term experiments placed at the site and by collecting rusticle samples, which are formed as a result of the bacteria activity at the site (Figure 5). The long-term test platforms placed near the wreck will aid in determining the rate of biocorrosion at the site. The microbiology data collected will also provide a comparative analysis for work Droycon is currently conducting on the RMS Titanic, DKM Bismarck, and the HMHS Britannic. Early biological analysis revealed a variety of rusticles present at the site including a rare white rusticle that was only previously found on the Bismarck.

Figure 6. Video capture photo of the *U-166* Conning Tower.

Sophisticated industry technology was utilized to overcome the challenges of conducting an archaeology/biology project in 1400 meters of water and accomplish the goals of the project. Sonsub's *Innovator* ROV had all the necessary components to complete the task. The *Innovator*'s 3000 meter depth rating was more than sufficient for working at the *U-166* site. The ROV utilized a Top Hat Drum TMS (Tether Management System), which not only insured safer working operations for the ROV, but also helped prevent the tether from entangling the wreck and damaging the site. The ROV was equipped with a high-resolution three-chip video camera, three additional operational video cameras and a high-resolution digital still camera. The images were transferred over a fiber optic tether to the *Ronald Brown* and recorded on digital miniDV tapes. All video footage was backed up on an additional miniDV deck, computer, and VHS.

Positioning of the ROV was critical to the success of the project and was accomplished using a Long BaseLine (LBL) array in conjunction with the

Sonardyne PHAROS positioning software. C & C's Marine Construction Division provided the survey crew for the project, which included Geoffrey Ellett, Jesse Harper, Brett Gunter, and Ron Dixon with Sonardyne. The acoustic array consisted of five compatt transponders positioned around the site with a Mk4 RovNav mounted on the ROV. Positioning for the *Ronald Brown* was provided by C & C's C-NAV global positioning system. A scatter test conducted during the operation indicated less than 6cm of horizontal deviation and the overall positioning accuracy for the project was approximately 15cm.

The *Innovator* was also equipped with both a five-function and seven-function manipulator. The seven-function manipulator arm's two-meter forward reach along with excellent pilot operations allowed placement of biological experiments and sample recovery in delicate and difficult to reach locations on the wreck.

The survey grid consisted of series parallel lines ran at 4.6 meter line spacing. The survey covered approximately 45 acres of seafloor around the *U-166*. Approximately 58 hours of digital video imagery was recorded along with over 1800 digital still and video capture images (Figure 6). Over 300 separate artifacts were recorded. Their information will be entered into a database and the data analyzed to gleem new details about the *U-166*, her crew, and the destruction of the U-boat. Based on this survey a detailed artifact distribution map is being developed and a preliminary site map is shown in Figure 7.

The education outreach component for the project was directed by Dr. Annalies Corbin of PAST Foundation and Dr. Dennis Aig with the Hunter Neil Company. PAST/Neil provided invaluable support for the project including a project web site that contains excellent background detail and provided daily updates during the field operations (www.pastfoundation.org/U166). PAST/Neil also

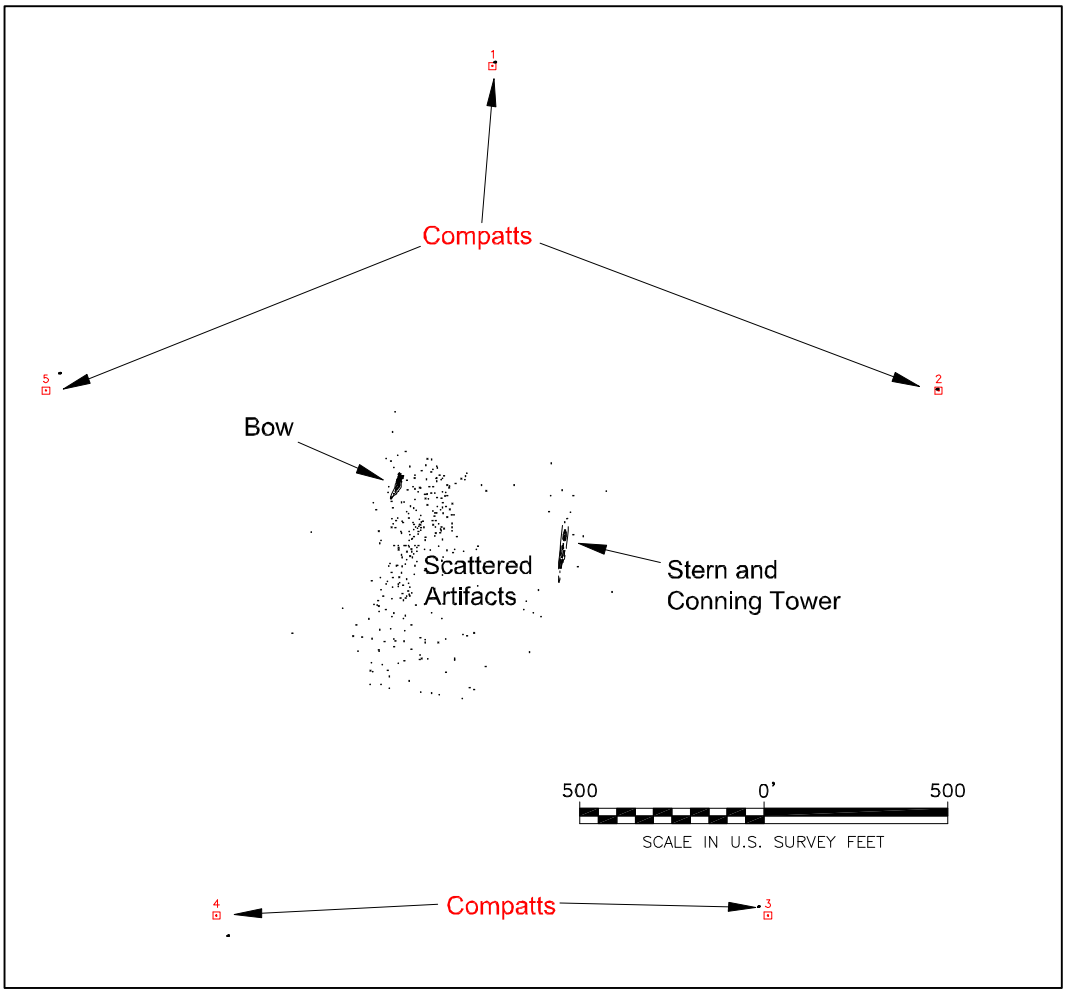

Figure 7. Preliminary Site Map

arranged for the New York film company, KPI to be on board during the project to film a documentary for the History Channel. Dr. Aig participated directly in the field operation and was an asset to the team assisting with the film operations, videotape management, and shift duties during the project. The documentary is scheduled to air on the Deep Sea Detective Series in April 2004.

In addition to the ROV survey C & C Technologies provided the *HUGIN 3000* AUV with its support vessel the R/V *Rig Supporter* to assist the project. C & C sponsored the *HUGIN* survey to collect additional AUV data on the site. Scott Melancon was the AUV crew chief on the *Rig Supporter* and the AUV data collected provided the highest resolution sonar and multibeam bathymetry data collected of the *U-166* to date.

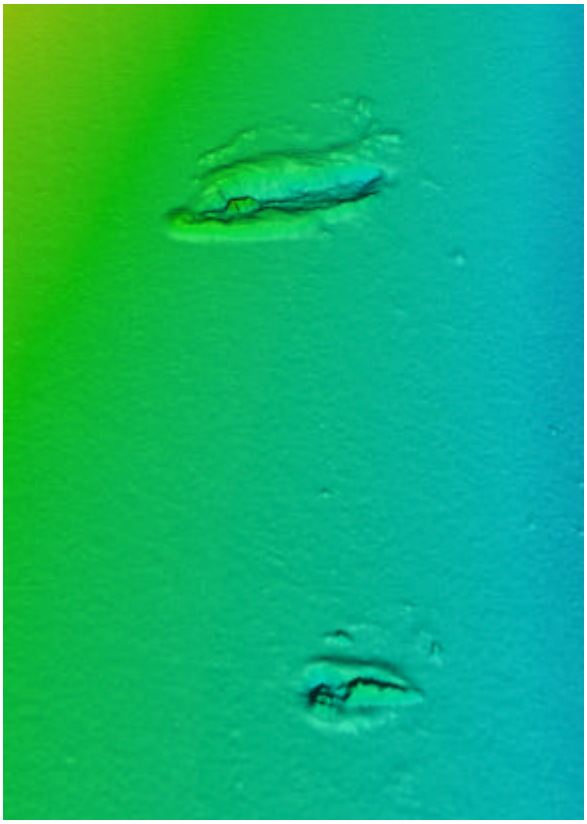

Figure 8. HUGIN 3000 AUV Multibeam Image of the *U-166* Site. The bow is at the bottom of the image and the main section of the U-boat is imbedded in the seafloor with the Conning Tower protruding out of the impact crater.

CONCLUSIONS

This multi-disciplinary project was a success because of the cooperative efforts of the government, the science community, and the ROV and survey industry. This was one of the first times that a full array of compatt beacons and the PHAROS positioning system were used on a deepwater archaeology project. The precision achieved during the survey sets a new standard for deepwater archaeology. This project is the deepest detailed archaeological project conducted in the Gulf of Mexico to date. Although no artifacts were removed during the project the video and photographic data collected will provide invaluable information to aid in piecing together these pages of our maritime past. The microbiology data collected will help advance that science further and will also provide a base study for additional work in the Gulf of Mexico. In the summer of 2004 a new expedition will take place to study as many as six additional shipwrecks in the Gulf of Mexico. The same multidisciplinary approach will be used and the information learned from the 2003 *U-166* Project will play a crucial role in planning these future deepwater shipwreck investigations.

REFERENCES

[1] War-Diary. *Oberkommando Kriegsmarine Kriegstagebuch, Akten betreffend U-166*, from March 24, 1942 through August 3, 1942. (NARA, Washington DC).

[2] "USS PC-566, Report of the Executive officer [H. C. Claudius] regarding actions with enemy submarine which torpedoed SS Robert E. Lee and rescue of survivors." August 5, 1942 (NARA, Washington DC).

[3] Robert A. Church and Daniel J. Warren. "Unraveling the Mystery: The Discovery of the *U-166*." Proceedings of the Minerals Management Service Information Transfer Meeting (ITM) (2002).

[4] Prior, D. B., E. H. Doyle, M. J. Kaluza, and M. M. Woods. "Technical advances in High-Resolution Hazard Surveying, Deepwater Gulf of Mexico." Offshore Technology Proceedings (1988).

[5] Jack B. Irion. "Cultural Resource Management of Shipwrecks on the Gulf of Mexico Outer Continental Slope." Paper presented at the 2nd MIT Conference on Technology, Archaeology, and the Deep Sea (April, 2002).

[6] The President's Panel on Ocean Exploration. *Discovering Earth's Final Frontier: A.U.S. Strategy for Ocean Exploration*. US Department of Commerce, National Oceanic and Atmospheric Administration. Award No. NA87GPO105 (2002).