NOAA Office of Ocean Exploration

Final Report Format

I. OVERVIEW

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Project Title Titanic Expedition 2004 – High Definition Mapping

Area of Operation (if applicable): Northern Atlantic

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Immersion Institute, National Geographic Society, Office of Naval Research, NOAA

Award Period: From 06/01/04 to _05/31/05_

Period Covered by this Report: From 06/01/04 to _05/31/05_ (ref: Semi-Annual Performance Report)

II. Summary

1. Abstract

In collaboration with the National Oceanic and Atmospheric Administration's (NOAA) Office of Ocean Exploration (OE), the Institute for Exploration (IFE) undertook a comparative assessment of the archaeological and biological changes that have occurred at the RMS *Titanic* wreck site between 1985, the year of its discovery, and the present. As a follow-up to the expedition mounted by NOAA/OE in June 2003, this expedition concentrated on surveying the *Titanic's* wreckage using state-of-the-art underwater photography and telecommunications equipment. We used our tandem ROV team of *Argus, Hercules* and *Little Hercules* to produce a detailed high-resolution photomosaic of the wreck site.

2. Purpose of Project:
   a. Describe issue that was addressed
   b. Describe/list the project objectives

At the time of the expedition, it had been almost twenty years since the *Titanic* was first discovered and the first scientific surveys of the wreck site were conducted. In journal articles resulting from the 1985 and 1986 surveys, the PI and his colleagues provided detailed maps of the debris fields surrounding the bow and stern sections of the ship as well as a detailed color photomosaic of the bow section. These surveys took place prior to the removal of artifacts from the site by salvagers and before extensive visitations to the site by deep submersibles leaving their descent weights, and ROVs that have entered and potentially modified the shipwreck's interior. These maps and mosaics form the baseline for the follow-up scientific survey of the site undertaken through this grant.

Conducting long-term comparative surveys of important underwater cultural sites like the *Titanic* is essential. The data that we collected will be used to create a database that clearly defines the present-day condition of the site. The comparative survey between present-day and 20 years ago will yield a baseline for temporal change of the site. Future surveys of the site will yield more comparative information. The resulting database will provide managers with valuable information for the wise management of this site. The database will help to determine the changes that have occurred as a result of natural processes compared to those caused by salvage operations or extensive visitation to the site by tourists or filmmakers.

The database also will form the basis for possible future efforts to slow, halt, and, in some cases, reverse the decaying process. Ultimately, the database may support the installation of long-term monitoring systems similar to the ones that

currently exist in several National Marine Sanctuaries, which allow real-time access to these sites by large numbers of individuals in a cost effective manner and without inducing further man-made change.

3. Approach:
    a. Describe the work that was performed

We returned to the *Titanic* aboard the NOAA ship *Ronald H. Brown* and undertook the collection of a series of photomosaics and high-definition video images using the latest in deep-water imaging technology. In addition, we brought biologists with previous *Titanic* sampling experience to undertake further study of the rusticles.

We used our *Argus* and *Little Hercules* optical imaging vehicles. *Argus* is a towed fiber-optic vehicle that has an array of visual and acoustic sensors including high-definition color video cameras, a color still camera, high-powered HMI lights, a scanning sonar, and altimeter. It also has powerful thrusters to control vehicle heading primarily so that its lights and cameras can always point to the region of interest. *Little Hercules* is a remotely operated vehicle also with high-definition video imaging capabilities, sophisticated vehicle control and sensors to maintain automatic depth and heading control, a scanning sonar and lighting system. We planned to create complete color mosaics of the horizontal decks of both the bow and stern as well as the vertical hull surfaces of the bow section. A series of survey lines were also made of the debris fields surrounding the wreck site.

We used acoustic and optical sensor systems to conduct precise surveys of the shipwreck site. Using the scanning sonar systems onboard the vehicles and a precision navigation system, a series of tracklines were driven above and along the length of the wreckage. As the vehicle transited, it collected downward-looking high-definition video and still images. The still images were digitally stitched together in near real time to produce detailed photomosaics. Tracklines were added to fill in any significant data gaps. The sonar also was used to generate a complete acoustic map of the wreckage sites.

This new survey data will be compared to the databases collected in 1985 and 1986 to determine the changes that have occurred over time in an effort to better understand which changes have occurred naturally and which changes were induced by human visitation.

Microbiologists participating in the expedition undertook a survey and evaluation of the rates of bio-deterioration of the wreck. Based on video material collected on expeditions from 1986 through 2003, participating microbiologists planned to visit selected sites for direct observation in order to confirm projected rates of deterioration. These sites are located throughout the shipwreck and include four steel test platforms. At the same time, video data recovered during this expedition will be integrated with existing images from previous expeditions for on-going assessment of the rates of bio-deterioration of *Titanic* and for extrapolation of future deterioration while on site in order to determine whether the rates of bio-deterioration are accelerating or slowing down over time.

<u>Pre-cruise Preparation</u>

During the past 8 years, the Institute for Exploration, with support from NOAA, the Office of Naval Research and private sources, has developed a suite of state-of-the-art imaging vehicles for use in deep water exploration and archaeology. IFE's vehicles have all been designed for operation to 3000 meters. In order to support investigation of the Titanic site (3800 meters), IFE upgraded these depth capabilities. The two main housings and their electrical penetrators on *Argus* were replaced with higher strength materials so that the vehicle was capable of operation at 6000 meters.

IFE engineers replaced the syntactic foam buoyancy package on *Little Hercules* with a package that could handle 4000-meter pressures. The main electronics housing were upgraded to 4000-meter capability and dedicated connectors were added to support 400-watt HMI lamps.

In support of the photomosaic data collection using *Little Hercules*, we leased an "Octans" north-seeking heading/attitude sensor, which is not affected by the magnetic field of the shipwreck, and *Little Hercules* was upgraded to utilize the *Hercules/Jason 2* control software package that uses an acoustic Doppler navigation system and the Octans to run precision tracklines. *Hercules* was retrofitted to operate at 4000-meter water depth.

The IFE vehicle systems are designed to use a Rochester 2351 steel-armored electro-optic main cable. We leased a 7000-meter cable for this expedition that will be mounted to our existing winch and handling system.

b. Describe how the project was organized and managed

The project was managed by the PI, IFE's Director of Research, IFE's Director of Engineering, and Director of Operations. NOAA OE provided management oversight because this project was a Signature Project for the program. The expedition team included participants from NOAA OE, IFE, URI's GSO, as well as a production team and web master. A cruise plan was developed for the expedition.

c. Describe how data was organized, processed, and archived

All raw data (digital files and video) collected during the cruise was logged and organized according to ROV dive number and synchronized by GMT time stamps. All data was backed up in triplicate and archived on hard RAID hard drive storage. When the ROV's were not diving, we relied on the ship's survey technician to organize the data, such as multibeam bathymetry data, which was also synchronized to other survey data by GMT time stamps. Preliminary processing of the data was performed onboard using specialized computer software packages, and that data was also archived on the primary RAID server. Further data processing occurred onshore to develop final data products, such as the final mosaic of Titanic's bow section. Once onshore, all data was backed up again onto another RAID storage system.

4. Findings:

a. Describe actual accomplishments and findings

The expedition was very successful in meeting its goals of mapping the current condition of the wreck site as well as determining changes that have occurred since its discovery. The expedition documented changes in the condition of the wreck, including the impact of submersible landings on the deck, along with natural and human caused degradations to the wreck and surrounding areas.

b. Inventory of activities (number of submersible dives, CTD, net tows, etc.)

More than 80 hours of high-definition video footage and more than 5,000 still images were collected. This database represents an archaeological baseline to gauge future deterioration of the wreck site and to implement future assessment and protection plans.

<u>Dive 1</u> - 2004/05/30 17:41:17.00 to 2004/05/31 09:38:32.00
HD tapes #s 1 and 2 - First dive on site, confirm wreck location and capture images of debris field and bow section. Unloaded plaque, unloaded sample box on seafloor, surfaced due to poor weather conditions. SEABEAM Survey, 40 nm box, E-W lines, 10kts conducted during time between Dive 1 and Dive 2.
<u>Dive 2</u> - 2004/05/31 22:08:16.00 to 2004/06/01 06:31:58.00
HD tape #3 - Vehicles deployed but technical problems prevented further evaluation of the wreck.
<u>Dive 3</u> - 2004/06/01 16:08:23.00 to 2004/06/02 11:34:12.00
HD tapes #3, 4, 5, 6, 7 - Herc and Argus used to photograph wreck and take images for bow mosaic.
<u>Dive 4</u> - 2004/06/03 16:15:55.00 to 2004/06/04 08:06:25.00
HD tapes #7, 8, 9, 10 - Explored and recorded images from wreck and debris field. Took images of James Cameron's plaque "The 1500 souls lost here still speak, reminding us always that the unthinkable can happen but for our vigilance, humility and compassion." Dive ended due to threat of inclement weather.
<u>Dive 5</u> - 2004/06/04 19:33:45.00 to 2004/06/07 10:18:21.00
HD tapes #11-29.

c. Inventory of samples collected

Samples for rusticle studies left on deck of bow section by Dr. Roy Cullimore in 1998 recovered and new samples placed on seafloor nearby.

d. Describe/list resulting publications, Web sites, presentations, etc.

A Book, entitled Return to Titanic, was published by National Geographic Press in fall, 2004
The expedition received extensive media attention, which benefited all of the organizations and agencies involved. Some highlights included articles in the Washington Post, Boston Globe, Los Angeles Times, People Magazine, Parade Magazine, Associated Press, and nearly 100 other journals. Television coverage was substantial, including live interviews on Good Morning America, ABC's 20/20, and segments on each major news broadcast including ABC, NBC, CBS, CNN and FOX. Radio coverage was equally extensive, with interviews on NPR Morning Edition, ABC Radio Tours, CBS Radio tours, AP Radio, etc.
A website was created by the partnering organizations and was linked to NOAA, IFE, Immersion, JASON, National Geographic, and EDS websites.
Web coverage of the expedition was extensive – with over 110 posting on websites, including all major media websites.

Immersion Presents and JASON Foundation for Education created live and post-produced educational programming throughout the expedition for a network of informal educational sites, including museums, aquariums, and for both classrooms and after school programs. An estimated 150,000 children took part in the informal and formal programming, and an additional 50,000 took part through Boys & Girls Club after school programs. In addition, extensive web-based educational programming was developed and available on Internet1 and Internet2.

e. Location and status of data archive and/or sample storage

Data archive is stored at the Institute for Archaeological Oceanography, University of Rhode Island Graduate School of Oceanography. Physical samples are stored by Dr. Roy Cullimore.

III. Evaluation:

1. Accomplishments – Explain special problems, differences between scheduled and accomplished work
2. Expenditures:

a. Describe original planned expenditures

Personnel	$75,627
Travel	$11,750
Equipment	$239,864
Supplies	$42,175
Contractors	$367,084
Other	$113,500

The budget included funds for the Titanic Expedition as well as to support the NOAA OE expedition Mountains of the Sea. Extensive vehicle and equipment modifications were needed to support the biological research program for Mountains of the Sea, as well as to enable the ROV vehicles to operate at the depth of the *Titanic* wreck site.

b. Describe actual expenditures

Expenditures during this period were:

Personnel	$69,749
Travel	$15,821
Equipment	$288,918
Supplies	$24,988
Contractors	$334,057
Other	$116,580

c. Explain special problems, differences between planned and actual expenditures

People costs were less than anticipated, however, equipment costs were higher, and airfares were slightly higher than predicted.

3. Next Steps:
    a. Planned or expected reports (professional papers, presentations, etc.)

Information about the expedition is routinely included in presentations and papers regarding deep water technology and archaeological oceanography.

    b. Brief description of need for additional work, if any (next project phase, new research questions, unaccomplished work, etc.)

There are no follow-up research programs being planned for this site at the moment.

Prepared By: _____ _____10/30/06
Signature of Principal Investigator Date