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DEEP SEA ARCHAEOLOGY RESEARCH GROUP

Cruise Report: 6 August 2001
USS Monitor - NOAA Monitor National Marine Sanctuary
August 2-4, 2001
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Overview:

The purpose of the expedition was to survey the turret of the USS *Monitor* and the surrounding seafloor using a high-frequency sub-bottom profiler with the intention of locating targets that will aid in future excavation of the site. Two particular artifacts where of interest – the pair of 11 inch Dahlgren guns believed to be still in the turret, and the rifle shield installed above the turret just prior to her sinking. The operations consisted of three 25 minute diver surveys covering the exposed underside of the turret outside her hull and the surrounding seafloor.

Background and Location:

John Broadwater, chief scientist of the *Monitor* National Marine Sanctuary, invited Professor David Mindell and Brian Bingham of MIT's DeepArch research group (http://mit.edu/sts/deeparch/) to the resting place of the USS *Monitor*. The MIT team brought their high frequency (150 kHz) sub-bottom profiler to investigate the turret and its surrounding area. Ideally, the images of targets buried on the site will aid the upcoming excavation. The surveys consisted of three trips to the sanctuary from Hatteras, NC on the R/V *Cape Fear* (UNC/Wilmington), where a team of divers dove on the 240' deep wreck site (the dive team had members from NOAA, National Undersea Research Center, the Maritime Studies Program at East Carolina University (ECU), and volunteers). The research team was there as part of NOAA's Ocean Explorer program for preserving the *Monitor*.

Survey Method:

The NOAA archaeological team, the participating divers, and the team from MIT's DeepArch laid out each day's survey. The resulting plan was a balance of potential target locations based on historical evidence, physical access due to the state of the wreck, and the spatial constraints of the instrument (survey altitude and orientation). The dive team

for a survey consisted of four divers – two to physically move the instrument through the survey pattern, one to tend the cable and relieve any current drag, and one to record the survey. On the surface, the MIT team operated the instrument and recorded the data, monitoring the progress of the survey by observing the data (Figure 4). The basic sequence of each day's survey was as follows:

- Pre-dive brief, surface team and divers discuss survey strategies and data punctuation.
- Test the transducer on deck and sync the topside PC clock with the video camera.
- Deploy the small-boat with the sub-bottom transducer and cable from the R/V *Cape Fear* at the site.
- Divers enter the water and remain along side the small boat on station.
- Retrieve the surface end of the transducer cable from the small boat, connect it aboard the *Cape Fear*, and verify the transducer operation (the small-boat and the *Cape Fear* remain tethered by the tow cable for the 25 minutes of bottom time).
- Divers descend to the site along the down-line with the transducer. (Figure 1)
- When on the bottom, one diver places the instrument at the survey height over the survey area and remains stationary, allowing the surface team to calibrate for altitude and sediment conditions (adjusting time-varying gain settings). The other divers prepare their gear on the bottom.
- When the survey is in place they communicate start of survey to the topside by raising and lowering the instrument to punctuate the data record. They remain in place for 60 seconds for further calibration.
- Divers then execute the survey plan, following structure on the wreck for spatial reference and punctuating the data record with raising and lowing of the transducer at the start and end of survey lines. Divers continue on a pre-determined plan until end of bottom time. (Figure 3)
- After 25 minutes on the bottom, divers attach a lift bag to the instrument and inflate it. Instrument rises to the surface and is recovered by the small boat.
- The cable is then removed from the *Cape Fear* to disconnect it from the small boat while the dive team ascended through their decompression stops (~1.5 hours).
- At debrief, the team views the video and discusses progress of the survey.

Figure 1: Handing the transducer off to diver (left) and descent (right)

Day 1 - August, 2

Dive Team: Survey-Tane and Keith; Cable-Steve; Video: Gary

The first day of survey was dedicated to refining the operational plan and accomplishing a preliminary survey along exposed structure within the turret area. The inside of the turret consisted of a variety of bottom conditions – two preliminary excavations pits inside the turret exposed the sediment and added to the relief and the undisturbed areas within the turret were reported to be a mix of course sand, shell hash, and coral growth. This survey of the inside of the turret was the primary objective.

Recommendations from the dive team led to adding buoyancy the profiler (initially 40lb in air and 20lb in water). The instrument was prepared by adding two turnbuckle handles between eye-

Day 2 - August, 3

Dive Team: Survey-Tane and Keith; Cable-Tami; Video: Gary

From the success of the first survey and with a clearer understanding of our capabilities and constraints, the second survey was conceived to complete the primary goal and survey the exposed area of the turret. The plan was 'mowing the lawn' survey with the divers moving the transducer along the armor belt and continuing to move in parallel tracks away from the armor until the entire turret was covered. After reviewing first day's data, the desired altitude of the survey was raised to approximately 2m to achieve the maximum amount of penetration by delaying the multiple echo bounces which can corrupt data taken at lower altitudes.

Divers entered the water at 10:10am. Again the survey results were better than expected. The divers executed the entire planned survey within the little allowable bottom time. The weight of the instrument along with the increased survey height did make surveying with the profiler a challenge. A more typical bottom current (1-1.5 kt) made it difficult to descend with the instrument and challenged the videographer to stay in position.

Figure 3: Divers surveying on day 2. Transducer moved along the armor belt looking down into the exposed turret. See figures 5 and 6 for resulting data.

Day 3 - August, 4

Dive Team: Survey-Tane and Steve; Cable-James; Video: Gary

On our calmest day of the three, the plan was to survey the seafloor immediately surrounding the turret. Just prior to the *Monitor*'s loss, a rifle shield was installed atop the turret. Knowing if that structure is intact and the general 3-D structure below the sediment would be valuable when planning the excavation and possible removal of the turret.

The survey was planned to run along the top lip of the turret (3m total height buried about 1m deep) and running around the circumference as far as possible. Circumnavigating the turret was not possible due to the decking above the turret around one side and the sedimentation around the turret armor, but the dive team did their best to cover as much ground as possible in challenging water with little room to maneuver. Both the video and the profiler data show a very dynamic topology with soft sediments, steel plates both flat and angled from the seafloor to the turret base, and two excavation test pits along side the turret armor.

The divers submerged at 10:28am with a less negatively buoyant transducer – another layer of syntactic foam was used to add buoyancy. The tight space, current, and transducer weight

proved to be a challenge to the dive team, but they managed to complete the survey almost covering the entire circumference with multiple passes.

Data and processing

The data from the trip was excellent, though it will take a while to fully process it, correlate it with the video (by time stamp) and publish. In general, the acoustic beam clearly penetrated the sediment, and objects and/or debris are clearly visible. The data comes out looking like cross sections of the turret and surrounding area, though, like all sonar, they require a fair amount of interpretation to understand. Figures 5 and 6 show a representative sample of the data. This is one survey line of about 6 on day 2, representing roughly 5% of the data collected. The end result will be a 3-d indication of high and low-density areas in the sediment, which will provide useful data to guide future excavations.

If the armor belt and deck plating are removed from the turret, it would be valuable to continue the survey, to cover the remaining 75% or so that was not mapped because of difficult access.

Figure 4: Viewing data on the surface, in real-time during diver survey.

Fig. 5

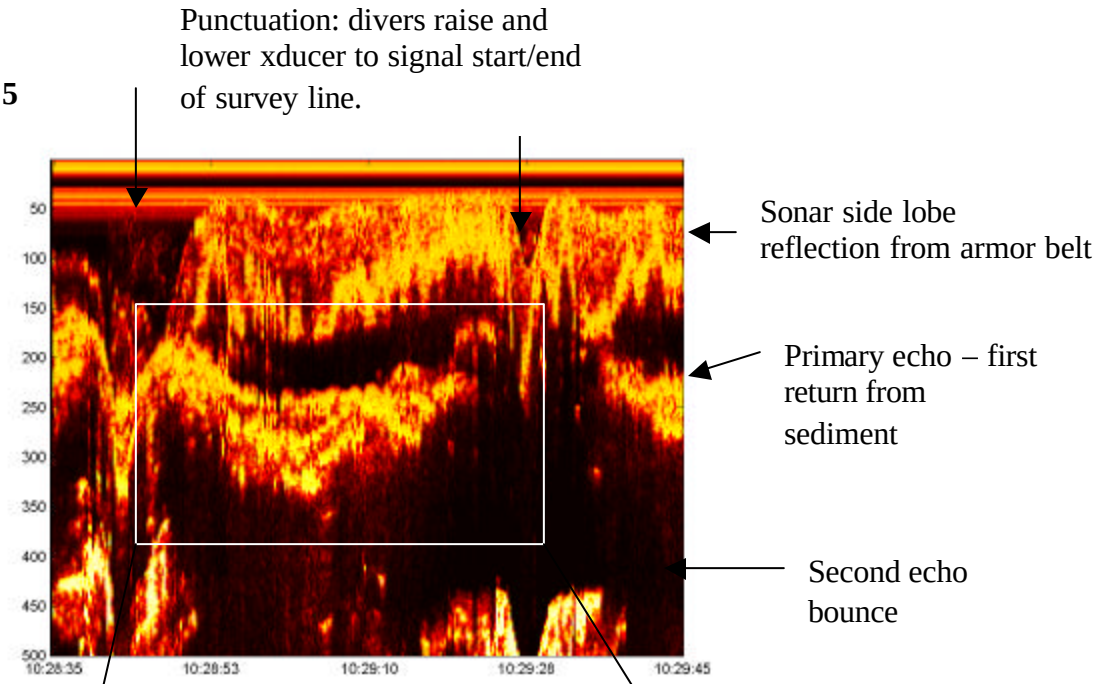
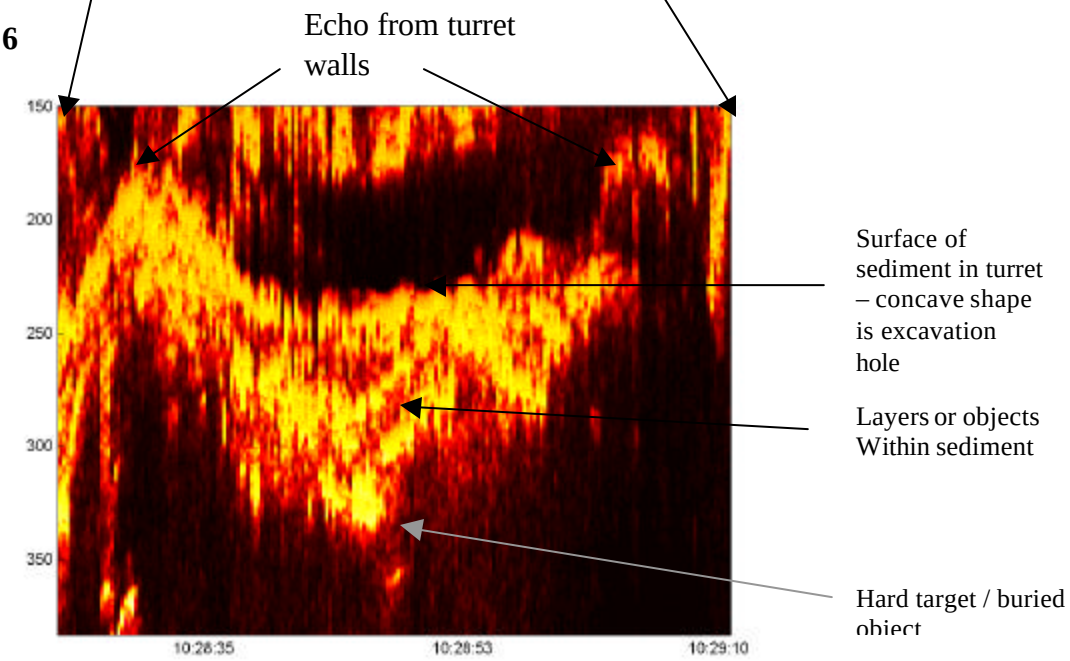


Fig. 6



Figures 5 & 6: Single survey line (day 2) as divers scan instrument across the exposed portion of the turret (fig. 5). Close up (fig. 5) of survey line. X axis is survey time, Y axis microseconds of acoustic travel time. Three distinct echoes indicate stratified sediment, or buried structure, and a distinct "hard" target is evident.

Personnel:

MIT Research Group in Deep Sea Archaeology:
David A. Mindell -- Director
Brian Bingham – Graduate student

NOAA Monitor National Marine Sancutary:
John Broadwater – Chief Scientist
Tane Casserley – Archaeologist
Jeff Johnston – Historian

R/V Cape Fear (UNC-Wilmington):
Dan Aspenlighter – Captain
Mike Radaway – First Mate

Divers:
Doug Kasserly – NURC
Jay - NURC
Tami Ebert – NURC Volunteer
James Fundeburk – NURC Volunteer
Ken - NURC
Steve Sellers – ECU
Gary Byrd – ECU
Keith Maverden –ECU