Tools to Study Maritime Heritage

Exploring and studying historic shipwrecks, plane wrecks, submerged landscapes or battlefields can be extremely challenging. These maritime heritage sites are often difficult to detect, hard to reach, and require specialized tools to effectively explore, identify, and evaluate them.

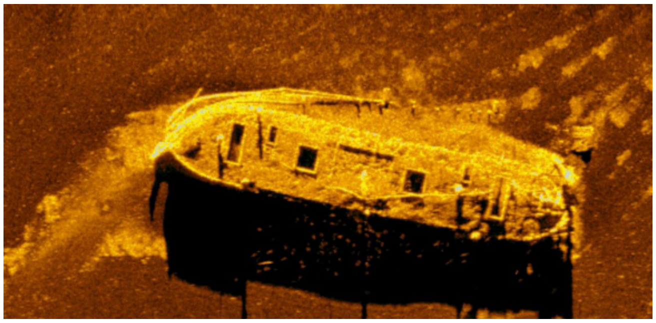
A technical diver surveys the Canal schooner *Walter B. Allen*, well-preserved in 49 meters (160 feet) of cold water in Lake Michigan's Wisconsin Shipwreck Coast National Marine Sanctuary. *Image courtesy of Tamara Thomsen/ Wisconsin Historical Society.*

What tools and technologies are used to explore maritime heritage sites?

Several different technologies and methods can be used to locate, survey, and document maritime heritage sites. Usually, these activities take place *in-situ*, meaning in their original position or location, and do not include site excavation or artifact removal.

Technical Diving

Technical divers rely on specialized training, equipment, and mixed gasses to safely dive beyond the recreational diving limit, descending to depths of over 90 meters (300 feet). Technical divers can explore, document, and monitor deep wrecks and other maritime heritage sites up-close.

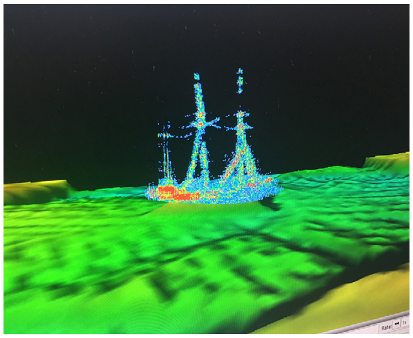


The historic vessel *Onondaga* as seen in side-scan sonar data collected by an autonomous underwater vehicle. *Image courtesy of NOAA/University of Delaware.*

Sonar

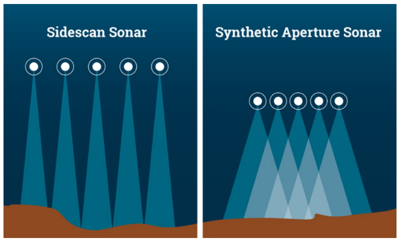
Sound Navigation And Ranging (SONAR) systems send out underwater sounds ("pings") and create underwater images based on the time and strength of the sound return (echoes). The structure, composition, height off the bottom, and orientation of an item will influence how strong and fast a return signal is received.

Side-Scan Sonar:
Side-scan sonar systems can be towed, mounted on a vessel, or placed on an autonomous or remotely operated vehicle. Hard objects send a strong return echo and create a dark image. Soft mud and sand produce weaker return echoes and create light areas. This tool can determine if there are objects on or below the seafloor.



Multibeam sonar Image of the schooner barge *Ironton* as it sits on the floor of lake Huron today. *Image courtesy of Ocean Exploration Trust/NOAA.*

Multibeam Sonar:
Side-scan sonar cannot measure depth, or bathymetry, so it is often used with a depth-measuring tool like multibeam sonar. Mounted on the hull of a vessel, multibeam systems send out multiple sound pulses in a fan-shaped pattern. Depth is computed by measuring the time it takes for the sound to leave the sonar array, hit the seafloor, and return to the array. The measurement of the intensity of the sound echo reflected back to the array is called backscatter, and can provide information about the geology of the seafloor or objects on it.



Synthetic Aperture Sonar:
Synthetic aperture sonar (SAS) sends out continuous pulses without processing the return pulses. It combines the returned signals, receiving multiple measurements of a single location at once. Acting like a "funnel" that overlaps with itself multiple times, the SAS gathers very detailed images and can map a site at 30 times the resolution of side-scan sonar.

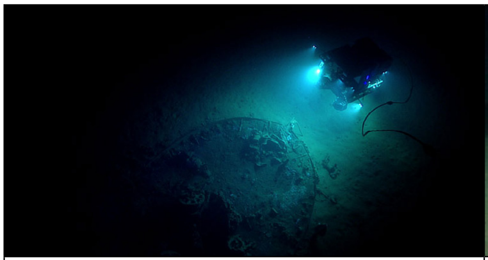
Magnetometry

A magnetometer is used to find magnetic anomalies submerged in the seafloor. Iron-based materials, like steel, have magnetic properties that are different from the surrounding magnetic field of the Earth. Towed behind a vessel or mounted on an autonomous underwater vehicle, this tool can detect items like anchors, stoves, or cannon balls.

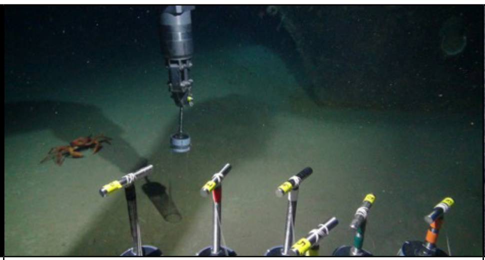
Remotely Operated Vehicle and Autonomous Underwater Vehicles

Remotely operated vehicles (ROVs) capture high-definition video and still imagery that can be studied in greater detail after an expedition is completed. This is especially important for shipwrecks, as teams create precise records of debris fields, document exact locations of artifacts, and work to understand their relationship to each other. ROVs can also be used to take water and sediment samples around a site to better understand the overall ecosystem in the area.

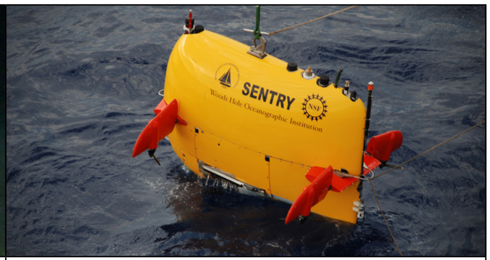
Autonomous underwater vehicles (AUVs) are self-powered vehicles sent on pre-programmed missions that can last several hours, days, or even weeks. AUVs, equipped with tools including sonar, magnetometers and cameras, are helpful for both shallow and deepwater work. Using AUVs allows for larger areas to be surveyed than divers or boats might be able to accomplish on their own.



The remotely operated vehicle *Deep Discoverer* explores the wreck of one of three mid-19th century merchant ships in the Gulf of Mexico, identified as the Monterrey Wrecks. *Image courtesy of NOAA Ocean Exploration.*



Sediment samples being collected with a push core near the bow of the *Anona* shipwreck. *Image courtesy of Hamdan Lab, collected by the Odysseus ROV.*

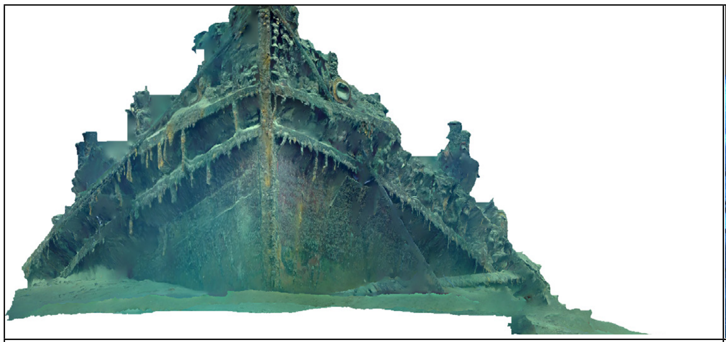


The autonomous underwater vehicle *Sentry* can travel to 6,000 meters depth, and carries both multibeam sonar and high-definition cameras. *Image courtesy of DEEP SEARCH 2017, NOAA-OER/BOEM/USGS.*

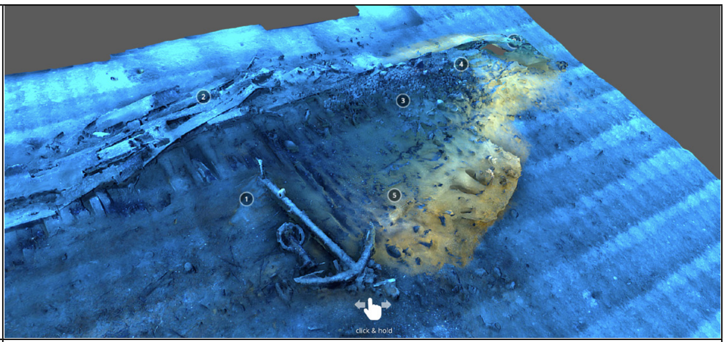
Photogrammetry

Photogrammetry uses two-dimensional images to create three-dimensional (3D) models or photomosaic maps. A camera (carried by a diver, ROV, or AUV) travels over a site in a pre-planned route, taking hundreds or thousands of overlapping shots from the top, sides, and inside of a structure. These photos are then imported into specialized computer software that digitally stitches them together by identifying overlapping points in multiple images.

A 3D model acts as a detailed snapshot in time and can reveal things that might otherwise be missed, allowing scientists to explore a site in great detail without physically disturbing it.



A photogrammetric model of the bow of tugboat *New Hope*, which sank in the Gulf of Mexico in 1965 during Tropical Storm Debbie. *Image courtesy of the Bureau of Ocean Energy Management.*



Visit the Bureau of Ocean Energy Management's Virtual Archaeology Museum to explore 3D models of wrecks like the Monterrey C Shipwreck found 1,219 meters (4,000 feet) deep in the Gulf of Mexico.

These, and other innovative tools, allow for selected maritime heritage exploration data to be easily shared and studied with the goal of better understanding and appreciation for these archaeological resources.

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