

Lead Hull-Sheathing of the *Santa Margarita*

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Of the many enemies of Spain's maritime lifeline, the shipworm (*Teredo navalis*) was one that was never quite defeated. The wood-boring mollusk found the planks of ships' hulls to be an excellent habitat and food source, and could transform a seaworthy vessel into a leaky sponge in as little as two years. The time and cost associated with careening and repairing vessels damaged by this nemesis forced a search for ways to at least slow the damage. For Spain's shipwrights, sheathing the hull was seen as one of the options.

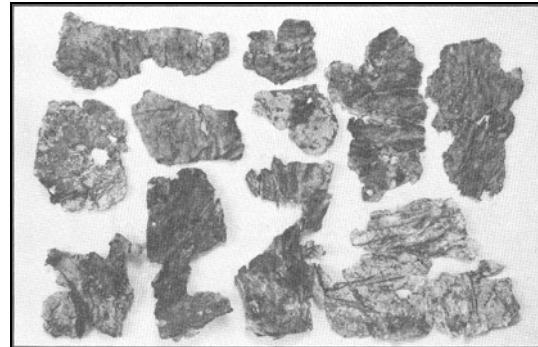
At the site of the wreck of the 1622 *Tierra Firme* galleon *Santa Margarita*, many thousands torn and crumpled fragments of lead sheathing have been found. These once formed larger sheets, which covered the ship below the waterline in an effort to keep the teredo worms at bay.

Many methods, and a variety of compounds have been employed in desperate attempts to stop shipworms from accessing the wood of the hulls. For centuries, coatings of tar, sulfur, pitch, fish-oil, animal fat, and wood or metal sheathing were all used in a variety of combinations before it was finally discovered in the mid-1700's that copper sheet provided the desired protection.

Lead sheeting was first used to protect the underside of ships as early as the 3rd century BC. After that it fell out of favor, only to be reintroduced several more times. The main drawback of covering a hull with lead was its electrolytic reaction with iron fasteners. Lead is higher on the electromotive scale than iron, and the nails would be corroded as sacrificial anodes when the two were immersed together in saltwater. Obviously, rotted fasteners did not contribute to the seaworthiness of ships, but, at the time, the electrochemical problems were not clearly understood, so the tradition persisted.

Another potential problem with lead hull sheathing is its high dead-weight. The *Margarita* sheet is quite thin, measuring between 0.5 and 0.9 mm, but still heavy. To estimate the mass it would have added to the ship, three 5cm X 5cm (25 cm sq.) samples were cut from randomly selected pieces of sheet. These samples weigh an average of 16.42g. This translates to an average weight of 6.568 kg/meter sq (12.1lbs/sq.yd). An

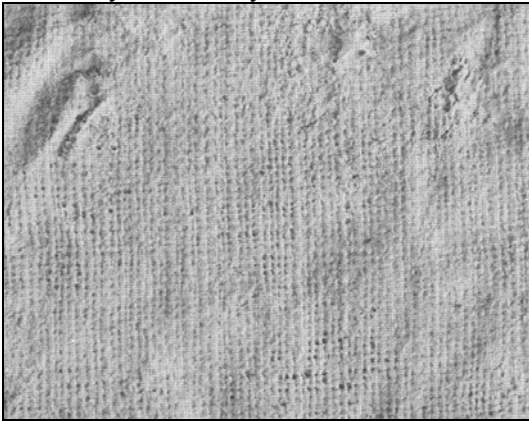
estimated 325 square-meters would have been needed to cover the 480-ton, Vizcayan-built *Santa Margarita* below the waterline. Based on these samples, approximately 2134.6 kg, or 4706 pounds, were added to the weight of the ship by its lead casing.



Pieces of lead sheathing recovered from the *Santa Margarita*.
Photo Dylan Kibler/MFMHS

The lead sheet used to protect the *Margarita* hull offers some interesting clues to the way it was used, and, possibly, manufactured. It is commonly thought that the sheathing was placed over a layer of canvas and pitch before being nailed into place. On other shipwrecks, lead has been found with a cloth impression, and this is thought to have resulted from the two being closely fastened to the hull, along with the compressing forces of the seawater. All of the sheathing that has been examined from the *Margarita* also shows a distinct, textile weave uniformly impressed into one side. A cast of this impression reveals a "plain-cloth" weave, and though the fiber type can not be determined, looks to be either canvas, burlap, or linen. Whether the cloth was used as an initial liner, between the lead and the hull, is not clear. These impressions are the only evidence for cloth being used in conjunction with the *Margarita* sheet, and there is none for pitch. The uniformity of the imprint, even along the edges, where there would have presumably been an overlap of the sheets, makes it seem unlikely that it resulted from the cloth and lead being tacked together against the hull. Additionally, the lead was torn and crumpled as the galleon broke up along the bottom, but no cloth or pitch has been found

pinched or trapped in the folds. Additionally, a bundle of six unused sections of lead sheet was recovered from the *Atocha*. They are all nearly the same size, ca. 44 X 46cm, 1.261kg, and were found stacked together, and folded in half. (An interesting sidelight about these *Atocha* pieces, is that they might be the pattern of the typical, “standard” size for lead sheet, and examples of the sort of shingle that originally covered the *Margarita*’s hull.) They were apparently being carried to patch any leaks that might spring during the voyage, and they too bear a clear, uniform cloth impression. For unused pieces to carry this trait makes it more likely that it resulted from the manufacturing process. Unfortunately, how lead sheet was manufactured in the early 17th century is not clear.



A cast positive of the cloth impression.
Photo Dylan Kibler/MFMHS

The recovered lead bears many holes pierced by the fasteners that held it in place. Though none of the fasteners has survived (likely due to the aforementioned electrolysis) these holes, along with impressions in the lead, reveal the

type that was used and the density of their spacing. The tacks that held the sheets to the hull had broad heads of 22mm diameter, and shanks 5mm square. They were spaced at 5-10 centimeters, with their placement tending toward the edges. The direction from which the tacks pierced the lead show that the sheets were placed with the cloth impression toward the hull, leaving a smooth exposed surface that was less friendly to adhering organisms.

Lead sheet in one form or another has been found on other Spanish vessels roughly contemporary to the *Santa Margarita*. The wrecks of the 1554 fleet found along Padre Island, Texas; the 1618 Honduran fleet’s *San Martín*, wrecked on Florida’s East coast; the mid-1500’s St. John’s wreck, the 1559 Emanuel Point wreck in Pensacola Bay, and the wrecks of the 1715 *Nueva España* fleet, have all produced lead sheet which was being used to cover seams, patch holes, or guard against shipworms. The sheet from these sites is generally described as similar to that from the *Santa Margarita* - thin, with a cloth impression - indicating that it was all used, or created in a comparable manner. Certainly, it does make it clear that lead sheet was a common, if not standard, component of the Spanish maritime material culture. Its broad use across such a long period of time indicates that, for its day, it was considered a success. These numerous bits of torn lead, sometimes an annoyance to the excavators and conservators, actually represent one of the many technologies that ensured the success of the galleons, some of the most complex machines of their time.

Sources Consulted:

Arnold, J. Barto III and Robert S. Weddle
1978 *The Nautical Archaeology of Padre Island: The Spanish Shipwrecks of 1554*.
Academic Press, New York.

Hodges, Henry
1976 *Artifacts*. Duckworth, London.

Laidlaw, Frederick B.
1952 “The History of the Prevention of Fouling.” in *United States Naval Institute Proceedings*, Vol. 78, pp. 769-779.

Mathewson, R. Duncan III and James J. Sinclair
1990 *East Coast Shipwreck Project: 1715 Spanish Plate Fleet Archaeological Report* -
1989. Cobb Coin Co. Key West, FL.

Smith, Roger C., James Spirek, John Bratten and Della Scott-Ireton
1995 The Emanuel Point Ship Archaeological Investigations. Florida Department of
State, Tallahassee.

Thanks to David Moore for calculating the area of the *Santa Margarita* below the waterline.