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Archaeometallurgical investigation of the iron anchor from the Tantura F shipwreck

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ARTICLE DATA

Article history:
Received 1 November 2012
Received in revised form
6 January 2013
Accepted 14 January 2013

Keywords:
Archaeometallurgy
Iron
Microstructure
Tantura F
T-shaped anchor
Wrought iron

ABSTRACT

The Tantura F shipwreck was a coaster or a fishing vessel about 15.7 m long, discovered in the Dor/Tantura lagoon, Israel in 1995. It was dated to between the mid-7th and the end of the 8th centuries CE. Among the finds excavated were two T-shaped type iron anchors. Of the two anchors, one (anchor A) was thoroughly studied by archaeometallurgical methods in order to identify forge-welding lines, to determine the welding quality and to understand the manufacturing technology. The examinations included X-ray radiography, XRF analysis, optical microscopy, SEM/EDS observation and analysis, OES analysis and microhardness tests. The investigation included characterization of the composition, microstructure, thermal treatments, forge-welding junctions and slag analysis. The results revealed a heterogeneous microstructure, rich in glassy, fayalite and wüstite slag. Iron based phases included ferrite, pearlite, cementite and Widmanstätten plates, all typical to wrought iron. The forge-welds of Anchor A were located. Each arm was made of one piece, weighing about 2.5–3 kg and the shank was made of a few 1.5–2 kg pieces. The second anchor (anchor B) was only briefly examined visually and with a few radiographs, which support the results from anchor A. The research results revealed significant information about T-shaped anchors and their manufacturing process, including hot-working processes without any additional heat treatments, and folding techniques. The microstructure was similar to other ancient simple tools such as saws, sickles, axes and mortise chisels, and though the technology to make complicated structures and objects, such as swords, existed at that time, the anchors did not require this sophistication; thus simpler techniques were used, presumably because they were more cost-effective.

1. Introduction

The Tantura F shipwreck is the remains of a coaster or a fishing vessel about 15.7 m long. It was discovered in 1995, about 70 m offshore in Dor (Tantura) lagoon, which is located on the Mediterranean coast of Israel, south of the ancient Tel Dor, about 25 km south of Haifa. It was found in about 1 m of water covered by about a 0.85 m layer of sand, the thickness of which changes due to sea conditions. Tantura F was excavated during five seasons in 2004–2008 [1–3]. Based on both ^{14}C and ceramic typological analysis, the shipwreck was dated to between the mid-seventh and the end of the eighth centuries CE—the local early Islamic period [2]. Among the finds exposed in the shipwreck site were two T-shaped iron anchors—anchor A and anchor B (Fig. 1). Anchor A was found beneath the hull, touching it (Fig. 1a), while anchor B was found concreted to the external part of the planking remains below the hull (Fig. 1b). The anchors were found covered by a thick grey layer of

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http://dx.doi.org/10.1016/j.matchar.2013.01.004

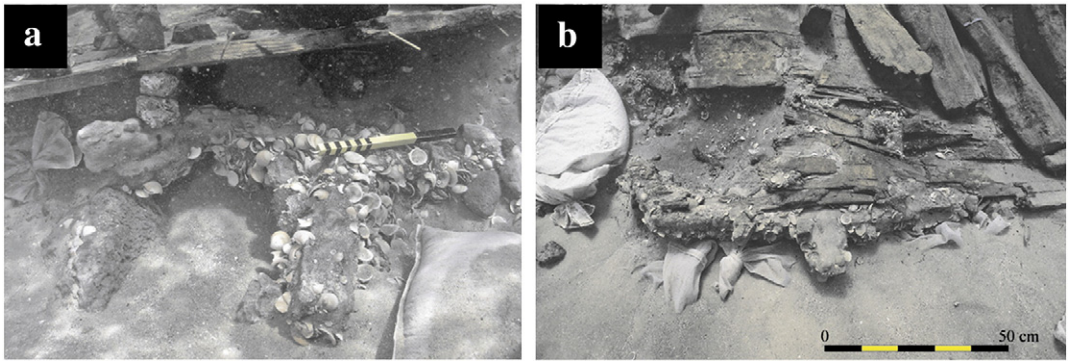

Fig. 1 – The Tantura F shipwreck anchors covered with thick encrustation and concretion: (a) anchor A and (b) anchor B.

encrustation and concretion composed of sea sand, shells and small stones. Both were broken at the shank, with part of the shank and the anchor cable ring missing.

The present study is part of a systematic series of investigations concerning the Tantura F shipwreck (e.g., [1–3]). According to Eliyahu et al. [3], the connection of the anchors to the wreck of Tantura F is based on their location at the site and their typology, considering the date of the shipwreck. Anchor A's typology was similar to anchors B and to other similar anchors such as the anchors found in the Yassıada I shipwreck [4]. The anchors were under the ship, which rules out the possibility that they were dropped after the wrecking of Tantura F. If the anchors had been dropped by a vessel earlier than the Tantura F, they would probably have sunk deeper into the sand, as a result of the activity of the sea, including waves, currents and sand movement inside the lagoon.

The anchors were removed from the seabed to the laboratory: Anchor A in the third season (2006), and anchor B in the fourth season (2007). After documentation and X-ray radiography, the concretion layers were removed carefully, while watching the radiographic images in order to cause minimum damage to the metal remains of the anchors. The cores of the artifacts were revealed: despite the heavy concretion and the oxidation process during 1300 years underwater, the metal survived in a good state of preservation—a hard core of iron was evident (Fig. 2 for anchor A). The arms of both anchors had a rectangular cross-section and were not precisely perpendicular to the shank. Their tips were flattened and the cross-sections of both shanks were circular, which is unusual for a wrought iron object, but characteristic of T-shaped iron anchors [3].

A wide variety of anchors in shape and material were used in antiquity, late antiquity, Byzantine (local), Early Islamic (local) and Middle Ages. They were developed according to the technological knowledge, capabilities, and experience, as well as requirements, considering the size of the vessel, and the nature of the ground, weather and water conditions [5].

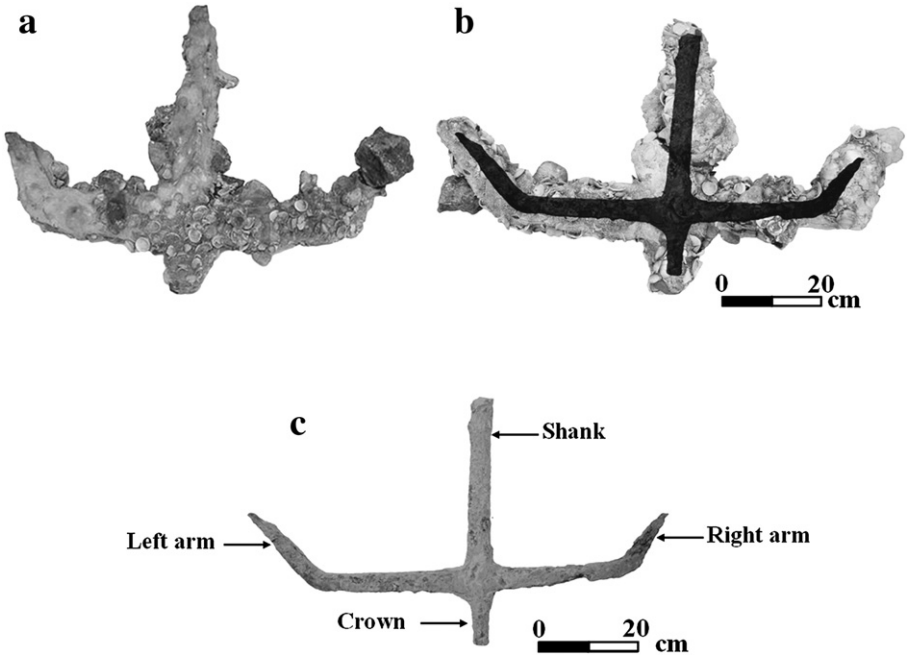

Fig. 2 – Anchor A: (a) covered with a thick concretion, (b) illustration of the iron remains, relative to the concreted artifact (estimated superposition, not a real cut) and (c) after the concretions layers were removed.