39. Understanding Life on the Pot: Marine Biofouling and Wreck-Site Formation Processes of the Kyrenia Shipwreck (Cyprus)

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The recruitment and colonization of the substrate by marine fouling organisms are complex processes. The transformation of bare substrate to complex and diverse communities, is one of the most challenging research topics in marine ecology. However, not everyone is that enthusiastic and the biofouling on archaeological artifacts is usually regarded as a nuisance that requires hours of work to remove.

The potential of using biofouling as an interpretative tool to aid in understanding site formation processes was tested in the case of the Kyrenia shipwreck. The composition and development of biofouling on 61 amphorae was characterized based on selected groups of species. A blind experiment approach was used to reconstruct the artifacts’ original position in the amphora wreck mound. The history of growth of the biofouling community on one particular amphora was examined for information on the wreck’s early site formation.

The results indicate that the amphora mound sustained well-developed fouling communities, which were similar to those found today in the areas close to the wreck site. Based on biofouling history and tell-tale patterns of growth, a scenario is suggested for the earliest phases of the wreck-site formation: several burial and exposure events, possibly seasonal-related, occurred within a few years until the lower layers of the wreck were permanently covered by seafloor sediments.

This study illustrates the advantages of diversifying the approach to understanding site formation processes. Biological data, such as the ones derived from biofouling, can be used as interpretative tools which complement archaeological science.

40. Studies on the Sedimentological Regime of the Mazotos Ancient Shipwreck, Offshore Cyprus

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Since 2006, a systematic underwater archaeological survey has been taking place around the Mazotos ancient shipwreck, dated to the fourth century BC. As this is a rare case of a coherent shipwreck site under excavation, the study of its formation processes was set as one of the main objectives of the project. For this purpose seismic profiles and core sediments retrieved from the wreck area were studied.

So far, three short cores of undisturbed sediments were collected from locations close to the wreck and one core was collected from sediments trapped in an amphora. The length of the recovered sediment cores ranges between 48 and 76cm. The sedimentological analysis focused on the determination of the grain size using a laser diffraction microgranulometer and the measurement of trace metal and mineral contents using ICPMS and X-ray diffraction techniques, respectively.

The seismic profiles so far suggest that the seafloor is covered by a sedimentary layer increasing in thickness southwards from the wreck site. This suggests an initial regulation in the sedimentation regime in the area due to the wreck. In addition, the acoustic signature of this layer implies that these sediments present variation in the grain size. Based on the granulometric data this pattern is more pronounced at the upper part of the layer since homogeneity characterizes the lower sedimentological phases, implying sedimentological alternations after the wrecking. The measurements of the trace metals contents in the same sediments suggest that the metals tend to cluster in groups with these groups and variations perhaps linked to clastic and biogenic sources. A different sedimentological pattern was obtained in the trapped sediments of the amphora. There, the isolated environment caused the dominance of the fine grained sediments and the participation of the gypsum and halite in the mineralogical content, suggesting the development of hypoxic conditions at the base of the amphora.

41. Post-Depositional Underwater Processes in Ceramics Found in an Oxygenated Environment at the Byzantine Anchorage of Dor, Israel

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The study of ceramic vessels and ballast stones from shipwrecks, anchorages and harbours is invaluable in understanding connectivity in the ancient world. Sourcing of ceramic vessels is routinely done through mineralogical compositions (e.g. XRD, petrography) and elemental analyses (e.g. NAA, XRF). Previous research, in lagoonal environments in the northern Mediterranean, noted that complex reduction processes occur in ceramics deposited underwater which result in formation of certain minerals and loss of others. These studies also asserted that a change in the lagoon environment caused future oxidation in pottery sherds, and argued that certain mineral species can serve as proxies for underwater environmental conditions.

The paper presents the first study exploring post-depositional changes to pottery collected from the largely oxidizing coastal environment of the eastern Mediterranean. Thirty one sherds representing 10 different ceramic types were collected in an underwater survey conducted in the Byzantine anchorage at the north bay of Tel Dor. Two of these ceramic types occur on land and a representative sample of these served as reference.

Despite deposition in a bay characterized by constant change of oxygenated water, stony and sandy (aerated) bottom deposits, all underwater ceramic types included the mineral pyrite which forms in reducing conditions. In addition, most sherds presented a pattern where pyrite was found internally, ca. 1-2mm from the sherd surfaces. This internal pyrite deposit was often surrounded by iron oxides out to the sherds’ surfaces.

These surprising results could be attributed to one of the following primary mechanisms: (a) deposition occurred in a reducing environment before it changed into the current oxidizing environment; (b) deposition occurred in an oxidizing environment but reducing conditions developed in the internal parts of the sherds. Future research will test these two possible scenarios.

The paper will also consider whether the findings affect the desalination process.

42. The Early Croatian Boats at Nin – Repair and Reconservation Begins

Marina Šimičić (International Centre for Underwater Archaeology in Zadar, Zadar, Croatia)

Since the 1980s the exhibition hall of the Museum of Nin Antiquities has been home to two early Croatian Condura Croatica Boats. Years of exposure and inappropriate microclimatic conditions, in combination with the questionable aspects of the conservation procedures undertaken at the time, have led to the present degraded condition of the exhibits. These boats, the oldest representatives of traditional Croatian boat building, have slowly sailed towards their utter ruin.

Aiming to change this course, conservation and restoration staff of the International Centre for Underwater Archaeology in Zadar began conservation and restoration work on the boats. In 2016 the first phase of conservation and restoration work was completed. This included studying and describing the previously conducted procedures, documenting the current condition of the boats and of the exhibition room, sampling for laboratory analysis and analysing the microclimate. A conservation and restoration report was drafted on the basis of the materials
collected and the analysis results. Future interventions were identified in order to minimise and prevent further deterioration and to repair the existing damage to the wooden material.

43. Dead vs. Med.: Characterization of Waterlogged Wood Finds from the Dead Sea and the Mediterranean

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Archaeological field surveys along the Dead Sea shore have yielded an array of cultural heritage remains spanning some 2700 years of maritime activity on the lake. These finds have been exposed due to the drop in the Dead Sea water level in recent decades and the exposure of vast areas of its former lake bed. Of particular importance is a group of uniquely preserved composite anchors made of wood, stone and rope. Along with other finds, including cargo remains, shoreline sites and other types of evidence, they shed new light on the maritime history of the lake and its unique maritime cultural landscape.

The technical analysis of the anchor finds from the Dead Sea was greatly assisted by the excellent state of preservation of their waterlogged organic components of wood and rope. This unusually high level of preservation contrasts with similar finds from other more common marine burial environments.

An investigation into the state of preservation of the waterlogged wood finds from the Dead Sea was deemed necessary in order to better understand their actual condition and prepare for their conservation and long-term preservation.

The study adopted a protocol commonly used for the assessment of archaeological waterlogged wood objects. It included micromorphological examination, physical tests, ash content and ATR-FTIR analyses. These analyses were applied both to archaeological waterlogged wood finds from the Dead Sea and to finds from the Tantura F wreck site located off the eastern Mediterranean Carmel coast.

The results showed reduced degradation levels within the waterlogged wood finds from the Dead Sea, and established a direct link between their improved physical stability upon drying and their
elevated mineral content. It was shown that Dead Sea minerals that migrated into the wood matrix during its prolonged submersion in the lake significantly reduced its shrinkage once exposed on the lake shores. The efficiency of this natural bulking process is expressed by the remarkable *anti-shrinkage efficiency* values (ASE) of over 90% measured within the Dead Sea sample group.

Altogether the results suggest that a different conservation approach may be adopted for the recovery and immediate storage of archaeological waterlogged wood finds from the Dead Sea, as well as for their longer-term treatment strategies and display.