Holistic Shipwreck Assemblages in 14th and 15th Century Southeast Asia



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Acknowledgements

I would like to dedicate this thesis to the person who has had my back for the last 23 years– My wife and best friend, Christina. I would also like to thank two people who constantly reminded me of life outside research, my kids, Jasper and Tessa.

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Abstract

The ceramic trade throughout Medieval Southeast Asia was prolific. Terrestrial sites have yielded massive amounts of ceramic material and the archaeological reports of shipwreck cargoes corroborate the versatile and extensive qualities of trade ceramics in the region. The sheer quantity of ceramic artefacts found in shipwreck assemblages, paired with a well-researched framework of the aesthetic, demonstrates that we rely heavily on ceramic data to date wrecks and establish regional trading patterns. While ceramics typically represent the bulk of the recovered material in these instances, many other types of material are present in the various assemblages. Yet these "lesser" materials suffer from a lack of investigation and, therefore, play virtually no role in the archaeological and historical assessment of the ship, its cargo, and its relationship to the maritime economy of the period. While ceramic studies may provide a general overview, a consideration of the other material provides subtlety and nuance to the analysis.

This case study focuses on the non-ceramic assemblages for six shipwrecks from the 14th and 15th Centuries of Southeast Asia (three Chinese-built and three Southeast Asian-styled junks). The typological study of the metallurgical, organic and geological material from these wrecks can complement much of the work surrounding existing trade models as well as reveal new concepts of crew life, belief systems and culture. These facets come together to offer a more holistic narrative as well as stimulating the need within the region for more study regarding the locations where past peoples mined and manufactured raw metals.

The thesis will also consider the motivations behind the excavators of these projects and what role this plays in the interpretation of the non-ceramic material. One wreck was excavated by treasure hunters, one was done by an amateur archaeologist and a curator, and a third was excavated by a governmental organization. Two excavations were conducted by a non-profit

foundation in conjunction with a National Museum and a final one was a purely academic excavation. Each party brings their own experiences and motivations to the excavation and therefore the systems of collection, curation, and conservation weigh heavily and are varied. These factors can determine what priorities each excavator brings to the analysis of excavated objects and the extent to which this effects the subsequent interpretation of the shipwreck.

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1.0 Introduction

The trade in ceramics throughout Medieval Southeast Asia was prolific. Terrestrial sites commonly yield large quantities of imported ceramic material and the archaeological reports of shipwreck cargoes corroborate the versatile and extensive range of ceramics traded within the region. The sheer quantity of ceramic artefacts found in shipwreck assemblages, paired with a well-researched framework on the aesthetics of these pieces, demonstrate that there is no doubt that scholarly narratives of maritime trade rely heavily on ceramic data to both establish regional trading patterns and date the ships in which they travelled. While ceramics typically represent the bulk of the recovered material from shipwrecks, crucially many other types of artefacts are also present in the various assemblages. Yet these "lesser" materials suffer from a lack of investigation and, therefore, play little or no active role in the archaeological and historical assessment of maritime trade in Medieval Southeast Asia. This thesis makes an attempt to correct this ceramic-centric bias and highlight the material that, due to its comparative absence in the scholarly record – either through a lack of trade at the time, or through a failure to recognise, excavate, conserve, analyse, and publish it during the recovery phase – play less of a part in the interpretation of shipwrecks and their cargoes than it deserves to. As we will see, it is only through the analysis of ***all*** classes of material remains from shipwrecks that a full understanding of the vessel, its cargo, and route can be interpreted. Ceramics alone can only get us so far.

This thesis focuses on the assemblages from six shipwrecks from the 14th and 15th Centuries of Southeast Asia (three Chinese-built ships and three ships built in the Southeast Asian tradition. The typological study of the metallurgical, organic and geological material, when added to the ceramics from these wrecks, complements and nuances much of the work surrounding existing trading models as well as revealing new views of crew life, belief systems and culture. These facets come together to offer a more holistic narrative for the ships themselves, as well as highlighting the pressing need within Southeast Asia for more study into the locations where past peoples mined and manufactured raw metals.

The thesis will also consider the motivations behind the excavators of these projects and what role this plays in the selection, preservation and interpretation – or not – of the non-ceramic material. Out of the six shipwrecks included in this thesis, one was excavated by a treasure hunter; another by an amateur archaeologist and a curator; a third by a governmental

organization; two were conducted by a non-profit foundation in conjunction with a National Museum; and finally one was a purely academic excavation. The personnel of each project brought their own experiences and motivations to the excavations and, therefore, the systems of collection, curation and conservation are varied and heavily influence the results and their later 're-usability'. These factors can determine what priorities each excavator brings to each excavation and its retrieval policy regarding different types of artefacts, which is heavily influenced by whether the excavations, are a purely academic endeavour, something purely profitable, or something in-between.

Five of the shipwreck assemblage lists were drawn up from various published sources on the respective wrecks and were supplemented by personal communications from some of the divers on these excavations. The wreck of the Santa Cruz has yet to be published. The reason for using this particular data set is to demonstrate the potential and pitfalls that researchers encounter when discussing unpublished material. The publication of the Santa Cruz is forthcoming and it is hoped that its researchers will be able to use this dissertation as a guide when analysing the assemblage of their wreck to better encompass the cargo as a whole, as well as help future researchers understand the potential if they collect everything from a shipwreck site.

Much of the published material on these shipwrecks lacked any illustrations or descriptions of any great detail pertaining to the non-ceramic material. It was therefore necessary to examine these materials personally in order to document them and corroborate this with information already published relating to these assemblages. Consequently, in the spring of 2013 I was able to re-research five of the six shipwrecks in this case study.[1] This included documenting the available metallurgical items of the Ko Si Chang III and the Rang Kwien ships at the Underwater Archaeology Museum in Chanthaburi, Thailand; the Lena Shoal and Santa Cruz wrecks at the National Museum of the Philippines in Manila; and the Bakau assemblage at the Maritime Experiential Museum in Sentosa, Singapore. The fieldwork enabled me to see the non-ceramic portions of the respective assemblages and rate their current condition, as well as establish contact with the various museums to understand the conservation processes pertaining to artefacts. It also offered the opportunity to speak with

[1] Unfortunately, despite repeated attempts to contact the National Museum of Malaysia, I was unable to obtain the necessary permissions to study the assemblage of the Turiang and was consequently forced solely to use the published material on the shipwreck.

local archaeologists that better understood the wreck sites, to tie the artefacts into the larger maritime context.

1.1 Interpreting the corpus of work

This thesis will mimic Brown's catalogue on the chronology of Thai trade wares.[2] Her goal was to group fourteenth and fifteenth century shipwrecks, glean their ceramic cargo in order to ascertain the presence (or absence) of ceramic material from different cultural areas or production areas (i.e. Chinese blue-and-white, Thai celadon, Vietnamese wares) and whether or not it corroborates with a ban on overseas trade during that time.[3] Using her grouping of dated shipwrecks, I attempt to glean the metallurgical, organic and mineral objects from the assemblages and reflect on any overlapping features of this material; both in terms of trading patterns of the material and in terms of what possible cultural significances these objects have. This is valuable to the larger archaeological community because it begins to interpret material that has been largely neglected, which offers new insights into what this extra material adds and the ways that allow for a better interpretation.

While Brown's work on Thai ceramics was an innovative achievement, it solely analysed the ceramics and largely ignored the rest of the cargoes. This analysis is the most widespread approach in Southeast Asia and is a methodological approach that needs to be expanded. Consequently, what I intend to achieve in this thesis is taking this analysis to the next step to look at the contents of the ships in total to see whether patterns in goods, travel, or maritime life are the same as those outlined by Brown, or more nuanced. The shipwrecks that comprise this case study are detailed below and listed chronologically, first highlighting those of the Early Ming Dynasty (1370 CE - 1430 CE), and then focusing on the wrecks of the Middle Ming Period (1450 CE-1510 CE) (Fig 1.1).[4]

[2] Brown 2009, pp.36–7
[3] Brown 2009, pp.36–7
[4] Brown 2009



Figure 1. 1: Shipwrecks used in this case study, highlighted in green. (Brown, 2008 pg. 16)

These shipwrecks were chosen for a number of reasons. Firstly, they represent an explosion of trade not seen previously in the archaeological record. There are 17 shipwrecks that date to before the 13th Century in Southeast Asia. Of those, 13 of them are dated between the 10th-13th Centuries and four of them date to before the 9th Century (Table 1.1). While this would be a sizable sampling, there are a number of problems with the quality and content of these shipwrecks. The published content on most of them is extremely limited, in some cases they are on an archaeological report that they exist and nothing more. Others, while having been excavated, only the ceramic cargo in their assemblages have been published. This can mean

that the ship exclusively had ceramics onboard at the time of the sinking, but more likely reflects a bias for material that is more popular. If the published material is not on the cargo it is commonly written solely on the ship's construction. Only three shipwrecks in this temporal group has properly vetted, published content as well as a regard for the whole of the cargo assemblage; The Beilitung wreck, the Intan wreck, and the Java Sea wreck. These were considered in the initial case study, but were left off due to the temporal dating of these wrecks. They are not attributed to the Ming Dynasty.

Table 1.1: Dated Pre-Ming Shipwrecks in Southeast Asia[5]

Ship Name	Age	Location	Reason for Exclusion
Butuan Boat I[6]	~3rd C.	Philippines	No cargo reported.
Pontian[7]	3rd-5th C.	Malaysia	Not enough published material. No cargo analysis.
Kolam Pinisi[8]	5th -7th C.	Indonesia	Published material solely on ship construction. No cargo.
Batu Hitam/Beilitung[9]	9th C.	Indonesia	Acceptable content. Decidedly out of the temporal dates of this thesis
Intan[10]	10th C.	Indonesia	Acceptable content and analysis. Decidedly out of the temporal dates of this thesis.
San Antonio[11]	11th -12th C.	Philippines	Published material solely on ceramic cargo.
Bolinao I[12]	12th-13th C.	Philippines	Published material solely on ceramic cargo.
Jepara late[13]	12th C.	Indonesia	Salvaged. No archaeological investigation.
Paya Pasir[14]	12th- 13th C.	Indonesia	Published material solely on Ship timbers.
Pulau Buaya[15]	12th -13th C.	Indonesia	Too little published material. Solely on ceramic cargo
Simanahan Reef[16]	12th C. ?	Philippines	No artefacts, no field report. Too little published material.

[5] Brown 2009, pp.170–171
[6] Green et al. 1995
[7] Evans 1927; Brown & Sjostrand 2000
[8] Manguin 1996; Flecker 2002a
[9] Flecker 2001b; Wilson & Flecker 2010
[10] Flecker 2002a
[11] Clark et al. 1989
[12] Clark et al. 1989
[13] Brown 2009, p.171
[14] Manguin 1989; Manguin 1996
[15] Brown 2009, p.171

South Balabec I, II[17]	'Song'	Philippines	Too little published material.
Breaker Reef Shoal[18]	13th C.	Philippines	Published material solely on ceramic cargo.
Butuan boats II-IX[19]	c. 13th C.	Philippines	No cargo recorded. Published material solely on ship construction.
Investigator Shoal[20]	13th C.	Philippines	Published material solely on ceramics.
Java Sea Wreck[21]	c. 1250 CE	Indonesia	Acceptable content. Decidely out of the temporal dates of this thesis.
Karang Cina[22]	12th- 13th C.	Indonesia	Salvaged wreck, no published material.

There are no shipwrecks in Southeast Asia that date to the Yuan Dynasty. After that, there is an resurgence of shipwrecks that date to the Early and Middle Ming period. There are 21 shipwrecks that date from 1368 CE- 1505CE.[23] Some of them suffer from the same problems as the earlier shipwrecks; no published references, published work on only one type of cargo (ceramics), or solely focused on ship construction. Others however share similar characteristics between sites that I have included. For example, of those 21 Ming shipwrecks, Brown and Sjostrand excavated four of them; the Turiang (1370-1400CE), the Longquan (1424-1440CE), the Nanyang (1425-1450CE), and the Royal Nanhai (1450-1487CE). The only wreck that was published in any detail was the Turiang.[24] Therefore, pragmatically it is the most logical choice to include the Turiang shipwreck, when one of the factors in choosing a shipwreck is a wreck excavated by private and academic interests.

The Bakau wreck was chosen because it was the only wreck in the date range that was excavated by a salvage company, yet had published material on the whole of the cargo. The Rang Kwien was included in the case study because it represented a state sponsored excavation that was used as a training exercise. There were a number of shipwrecks that

[16] Orillaneda 2013
[17] Brown 2009, p.171
[18] Goddio et al. 1997
[19] Green et al. 1995
[20] Goddio et al. 1997
[21] Flecker 2002a; Flecker 2003
[22] Brown 2009, p.171
[23] Brown 2009, pp.172–174
[24] Brown & Sjostrand 2000; Brown 2009; Sjostrand & Barnes 2001

ticked this box, but none had published material that was as extensive and through as the Rang Kwien. The Ko Si Chang III was chosen due to its connection to an academic and state sponsored partnership, and the Lena Shoal and Santa Cruz were included because they represented excavations between a private non-profit organisation and a state-sponsored archaeological unit. One of these wrecks was published (Lena Shoal) and one was unpublished (Santa Cruz), which gives us the opportunity to look at how access to raw, unpublished data can be used to create a network of artefact analysis, rather than using the published material.

There were a few additional wrecks that fit the date range of this study with extremely well published material that could have been a part of this grouping; specifically the Brunei wreck[25], The Ko Khram[26], and the Pandanan[27]. The reason for their omission was largely due to geography. The Panadan and Brunei wreck were found in the same area as the Lena Shoal. The Pandanan wreck was also similar to the Rang Kwien, sponsored by a state-run archaeological team. The Ko Khram was found in Thailand. I felt that these were already represented within the case study with other shipwrecks.

1505-1510CE is the upper limit of the case study for two reasons. Firstly, it signifies a Dynastic change in China, from the Emporer Hongzhi Era (1488-1505CE) and the Emporer Zhengde Era (1506-1521). There are only 6 ships dating to the Zhengde Era[28], and only one of them (Ko Samui) has any published material on the cargo. Secondly, European powers enter the area and invade the Sultanate of Molucca. This begins a change in trading patterns that would change the scope of the thesis. Trade patterns change distinctively after European contact, and there are a number of written records of trade in the region at that time.[29] We know little about the trade just before Europeans sail into Southeast Asia. This will be, however, a great opportunity for a comparison study in the future.

These wrecks were also chosen because they represent excavations conducted by a diverse group of parties. Most of these excavations were fully sanctioned, supervised and undertaken by academic departments of archaeology throughout Southeast Asia and Australia, or through cultural heritage schemes with national museums. Others were excavations and surveys

[25] L'Hour 2001a; L'Hour 2001b
[26] Green & Harper 1983; Intakosai 1984
[27] Diem 1998; Tanaka & Dizon 2011
[28] Brown 2009, p.174
[29] For comprehensive histories see Reid 1993; Wade 2009; Hall 2011. For early written accounts see Borri 1633; La Loubere 1693; Herrera et al. 1726; Pires 1978.

conducted by well-known and respected members of the academic community, or were private excavations in conjunction with academics from the region. I am discussing the different archaeological methods used to survey, remove, conserve and interpret these assemblages; therefore it is necessary to cover the myriad of archaeological motivations behind these excavations. Because the motivations are different for each project, it is important to understand motivation if you wish to understand the assemblage.

They also reflect the wide stretch of Southeast Asia in an attempt to encompass material throughout the region. The Turiang was found in Peninsular Malaysia, the Bakau in Indonesia, the Ko Si Chang III and Rang Kwien in the Gulf of Thailand, The Lena Shoal along the Palawan coast in the Philippines and the Santa Cruz in Lingayen Gulf, also in the Philippines.

1.1.1 Wrecks comprising this case study

1.1.1.1 Early Ming Wrecks:

Turiang (1370CE-1400 CE):

The Turiang was a shipwreck found in May of 1998, 100 nautical miles off the coast of Peninsular Malaysia at a depth of 42 metres.[30] By the time the site was accessed and properly surveyed, trawling nets had significantly damaged the upper layers of the site. Excavation crews conducted a pre-disturbance survey, mapping all visible features within the site. A numbered reference line guided the survey with lateral measurements taken at every metre. 'Ceramics' were then recovered from the surface and from shallow pits and recorded on a grid. It is interesting to note the term "ceramics" in this sentence. This could reflect why so little else was recovered from the wreck site, as I will note in subsequent chapters. [31] Radiocarbon dating of the wreck was conducted by analysing a piece of the structural timber, putting its construction somewhere between 1305 and 1435 CE (95% probability).

The excavation was a collaborative project between Sten Sjostrand, marine engineer and amateur archaeologist, and Dr Roxanna Brown, a leading authority on Southeast Asian Ceramics and then director of Bangkok University's Southeast Asian Ceramics Museum. The recovered artefacts were accessioned and analysed. A percentage of the artefacts were given

[30] Brown & Sjostrand 2000, p.11
[31] Sjostrand & Barnes 2001; Barnes 2012; Brown & Sjostrand 2000, p.40

to Sjostrand to sell, to finance the excavation of the Turiang. The remaining material became the property of the Malaysian State. It is housed at the National Museum in Kuala Lumpur. A catalogue of the ship's cargo was published, and a museum exhibition was held to display some of the cargo that was recovered.[32] Tragically, all of the excavation data was lost when Sjostrand's own ship sank.[33] Sjostrand's familiarity with underwater excavation techniques paired with Brown's acumen for scholastic rigor make this a very strong professional partnership. The excavation was conducted to academic standards, even though the data was destroyed and the ceramic assemblage scattered through its sale. Analysis of the nautical architecture of the hull and wood samples taken from the ship, Brown and Sjostrand suggested that the ship itself was built in China.[34]

Rang Kwien (1400CE-1430 CE)

The Rang Kwien was found 10 kilometres off the coast of Bang Saray, Chonburi province, Thailand at a depth of 22 metres. The Underwater Archaeology Division (UAD) of Thailand was aware of the wreck in the mid-1970s, but funds and equipment were not acquired to survey and excavate the site until 1978. Yearly excavations were systematically conducted from 1979 until 1981.[35] The site was revisited in 2003 to train teams in surveying, then again in 2013 for survey as well as excavation training.[36] The whole of the assemblage was housed at the Underwater Archaeology Division (UAD) in Chanthaburi, Thailand and select items are presently on display at its Underwater Archaeology Museum onsite. Articles and presentations have been published on the cargo.[37] Brown is under the impression that the ship was built in either China or Japan. I believe her assumption is based upon the cargo.[38] Sira Ploymukda of the Underwater Archaeology Division in Thailand makes the same claim, but due to the iconographic decorations found on the stern castle in the 2013 excavation.[39] It is difficult to agree with their findings, since the ship had dowels rather than iron nails to connect the hull together. Radiocarbon dating was conducted on the hull to ascertain the date of the ship.

Bakau (1410-1430 CE)

[32] Brown & Sjostrand 2000
[33] Sjostrand et al. 2006, p.57
[34] 2000, pp.12–13
[35] Intakosai 1983
[36] Sankhaprasit 2013; Vatcharangkul 2013; Ploymukda 2013a
[37] Intakosai 1983; Intakosai 1984; Ploymukda 2013a
[38] Brown 2009, p.172
[39] Ploymukda 2013a

The Bakau wreck is named for the island from which it was found, on the western side of the Karimata Strait in Indonesia. It is also known as the Maranei wreck. It was discovered in about 24 metres of water and excavated in 1999 by the salvage company, Seabed Explorations. It is unknown how systematic the survey and subsequent excavation was. The only published material on this wreck was by Michael Flecker in 2001,[40] who managed to dive and inspect the wreck at the end of the salvage, when the only artefacts left in the water at that time were the hull fragments and some heavily silted jars. Due to the iron nails found and the type of lumber used, Flecker suggested that the Bakau was a Chinese built ship.[41] Radiocarbon dating of the hull placed the Bakau wreck securely in the 15th Century.

The Bakau is unique in the sense that the whole of the assemblage was sold to the Maritime Experiential Museum in Singapore. This was the second salvaged ship's cargo to be wholly bought by Singapore.[42] The case has been made that Tilman Walterfang's (Owner of Seabed Explorations) intention was to not sell off the Bakau piece-by-piece in order to allow the chance for someone to study the entire assemblage.[43] There are merits to this line of thinking, as we shall see when we study the whole of the assemblage in this thesis. There is, however, only one article published on the Bakau, which gives the excavation some academic credibility, yet it is questionable just how much less we would know about this wreck if it were not for Flecker luckily visiting the site at the end of the excavation and publishing his observations.[44] Brown did see a draft copy of the catalogue for the Bakau, but this is unfortunately yet to be published.[45]

The Maritime Experiential Museum in Resorts World Sentosa, Singapore houses the whole of the artefact assemblage. I was the first academic to reach out to the Museum to study the material.

1.1.1.2 Middle Ming Wrecks:

Ko Si Chang III (1460CE-1487 CE)

The Ko Si Chang III wreck site lies nearly six miles off the northern cost of Ko Si Chang,

[40] 2001b
[41] Flecker 2001b; Brown 2009, p.172
[42] The first wreck assemblage purchased was the Beilitung wreck, a 9th Century wreck found off the coast of Java.
[43] Walterfang n.d.
[44] 2001b; Ploymukda 2013a
[45] Brown 2009, p.172 refers to an unpublished catalogue of the Maranei (Bakau) wreck in Table 12, Authored by Rolf Marie in 2002 for Seabed Explorations Gmbh &Co..

Thailand, at a depth of approximately 24 metres. This project was a collaboration between a large number of groups, with the team consisting of divers from the Underwater Archaeology Division of the Thai Fine Arts Department, trainees from the Southeast Asian Ministers of Education Organization Project in Archaeology and Fine Arts (SEAMEO-SPAFA), as well as members from the Australian Institute of Maritime Archaeology (AIMA). Staff from the Western Australian Maritime Museum, Torun University, the Underwater Society of British Columbia and the Ministré de le Culture (DRASM), France were also present, as well as trainees from the Philippines, Indonesia, Thailand and Malaysia.

Initial surveys of this site revealed it being the first shipwreck found in the Gulf of Thailand that had not been subjected to looting.[46] Due to its pristine nature, the Thai-Australian Underwater Archaeological Research team decided that urgency was needed to excavate the site.[47] Since the team is made up largely of academics, the process of survey, excavation, and conservation was acutely detailed and made public in a number of articles.[48]

Excavation of the wreck recovered a sizable artefact assemblage, but also revealed an intact keel and bottom planking, including the remnants of nine bulkheads and the mast step. The use of dowels instead of nails suggested that the Ko Si Chang III was a Southeast Asian ship, built in the hybrid junk tradition. The spatial distribution of the cargo on the ship – since the bulk of it was still in their respective bulkheads – revealed methods of lading on a ship like this as well as positing suggestions as to how the ship broke up on its way to the ocean floor. Radiocarbon dating of the hull dated the wreck to the Middle Ming Period.

Lena Shoal (1488CE-1505CE)

The Lena Shoal was located in 1996, off the island of Busuanga, northwest Palawan, Philippines, at a depth of 48 metres. The site survey and excavation was completed by the National Museum of the Philippines along with Franck Goddio and the Far Eastern Foundation for Nautical Archaeology (FEFNA). The project came together very quickly. What was initially a survey season for the Institut Européen d'Archéologie Sous-Marine (IEASM) became a rescue mission when the National Museum of the Philippines requested assistance to excavate a vessel under threat of looting. Within two weeks, barges were

[46] Green & Harper 1983
[47] Green et al. 1987
[48] Green et al. 1987; Green 1990

anchored over the site, an excavation plan was in place, and a team of divers and conservators were ready to commence.[49] The excavation was well executed and properly recorded. A number of publications have been published on the materials excavated from the Lena Shoal.[50] The Lena Shoal shipwreck was identified as part of the South China Sea shipbuilding tradition. It had Chinese characteristics of watertight bulkheads, yet was constructed with Southeast Asian woods and fastened together with wooden dowels instead of nails.[51]

The artefact assemblage was split between the National Museum of the Philippines and the HILTI Foundation who financed the excavations. However, none of the material apportioned to the Foundation was sold and it remains in storage.

Santa Cruz (1488CE-1505CE)

The shipwreck was discovered at 32m below sea level, in Santa Cruz, Zambales, Northern Luzon, Philippines. The excavation was another collaboration between FEFNA and the National Museum of the Philippines. The ship is estimated to be from the South China Sea in terms of its shipbuilding tradition.[52] The survey, excavation and conservation was conducted with academic rigor, with all reports available to research parties. Presently, little has been published on the material from this shipwreck, nevertheless a large academic volume on the wreck is in preparation and set to be published within the next few years.[53] Like the assemblage from the Lena Shoal wreck, the artefacts from the Santa Cruz were also split between the HILTI Foundation and the National Museum. Radiocarbon dating for both was dated to the Hongzhi Era, through shipwreck timber analysis.

1.1.2 The wrecking process

In the process of wrecking, a ship undergoes a number of transformational processes. Each wreck is unique, with a series of interacting variables that constitute the circumstances surrounding the loss of a ship. Environmental factors, such as depth, turbulence and geological topography, coupled with material factors, such as ship's construction and cargo makeup, coalesce with circumstantial factors of weather and human choice to create the characteristics of each wreck site. These characteristics can create an ideal wreck site with

[49] Goddio et al. 2002, pp.12–13
[50] Goddio et al. 1997; Goddio 2000; Goddio et al. 2002; Fahy 2011; Kintanar 2014
[51] Orillaneda 2013
[52] Orillaneda 2008c; Orillaneda 2012
[53] Orillaneda 2014b; Kintanar 2014

complete preservation with sites like the Vasa[54], the Mary Rose[55], and the Amsterdam[56] where the ship is more or less completely preserved and in situ. The other characteristic extreme would be if circumstantial factors affect a site so greatly that it ceases to look like a wreck site due to disbursement, deterioration, and destruction (e.g. Brascombe Bay Bronze Age 'ship', so deteriorated that only the cargo remains).[57]

As the wrecking event occurs an initial phase of redistribution begins.[58] Material not heavy enough or not tied down or contained will sink at a slower rate or float away. As the ship begins to rests on the sea floor, a second phase of redistribution occurs. The geographical and geological topography will determine how the ship lays. If the ship wrecks on an incline, material can slide to a deeper depth. The ship may break up if it lands on a layer of rock, or may settle in a complete state if the bottom is made up of silt or sand.

After settling on the seafloor, various mechanical, biological and chemical processes begin to affect the wreck. Exposed parts of the ship; parts that are not covered by sand or silt or other objects, begin to degrade and are slowly destroyed by wave action, trawling, worms and salt. Wave action and currents usually have an adverse affect on a wreck, yet can distribute sand and silt to slowly cover a wreck thereby aiding in its preservation.

The compression of layered sediment gives shipwrecks a degree of protection from the agents in seawater that cause erosion and corrosion. This protection can be so effective that the portion of hull encapsulated within the layer can be preserved. The sediment, in combination with cargo assemblages contribute to the preservation of the hull portion that comes to rest on the ocean bottom. The sections of the hull that were not protectedare usually destroyed. Muckelroy cites both classical examples of this wreck preservation scenario as well as more modern wrecks that are affected by similar conditions.[59] In the case of this shipwreck study, the ships under larger layers of undisturbed sediment had portions of their hull that were preserved. The hulls of the Rang Kwien (22 meters) and the Santa Cruz (32 meters) were mostly undisturbed at these depths. They were also not in areas that are heavily trawled resulting in the sediment remaining undisturbed. The Lena Shoal (~48 meters) was initially found by trawlers, yet the trawling damage was localized to a small portion of the wreck. The Turiang, found at 42 meters, was deep enough to hinder wave action which would allow for

[54] Hocker 2011
[55] Gardiner & Allen 2005
[56] Marsden 1985
[57] Tyson 2010
[58] Muckelroy 1978, p.158, Schiffer 1983, and Martin 2011.
[59] Muckelroy 1978, pp.170–1

an undisturbed layer of sediment, but it was located within a heavy trawling area therefore the site was continually dragged and spread apart over may years. The Bakau and the Ko Si Chang III were found in shallower waters (~25 meters) and in heavily trawled areas, leading to continually disturbed layers of sediment and sites vastly spread out along the ocean floor. While many of these wrecks had portions of their hulls preserved, the ones in deeper, less trawled waters had more of their hulls and their cargo in place and intact.

1.1.3 Shipwreck discovery/recovery

Shipwrecks in Southeast Asia are discovered two ways: either accidentally, or purposefully. This second process typically is separated into wrecks excavated for academic research, and those for commercial reasons.

1.1.3.1 Accidental discovery of shipwrecks

Otter boards on trawler nets seem to be both a blessing and a curse to the scholarship of underwater wrecks (Fig. 1.2).[60] In Southeast Asia often the first 'contact' with a wreck is usually made by local fishermen, when artefacts become caught in trawling nets, thereby revealing the general location of a new shipwreck.[61] A great price is paid, though, for such information. The artefacts caught in the trawling nets are scraped up from the wreck site resulting in sizeable grooves made along the seabed, directly through the wreck sites, which destroys not only material on the surface but also large amounts of the buried assemblage, as well as scattering material around the site. Otter boards have the capacity to penetrate 8-17 cm into the seabed in muddy environments and up to 5 cm through sand (Fig 1.2).[62]

The accidental discovery of shipwrecks can also happen through commercial surveys. The Brunei wreck was found during a geophysical survey of the seabed to lay down a pipeline.[63] The Pandanan was found because of a pearl farm that was expanding and setting up in he area.[64]

[60] Otter Boards are flat pieces of wood or metal attached to trawling nets that serve multiple functions. They are designed to use hydrodynamic force to keep trawling nets open while in use. They also scrape the bottom of the ocean floor causing sediment to kick up around the net, which effectively hides the net from escaping fish.
[61] Flecker 2002b
[62] Kingsley 2012; Linnane et al. 2000
[63] L'Hour 2001a, p.6
[64] Dizon 1998; Diem 1998

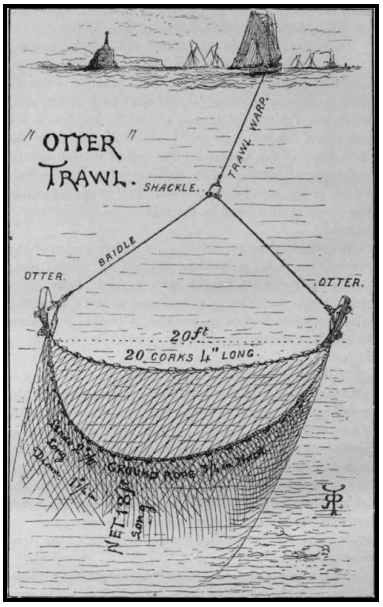


Figure 1. 2: Otter boards and trawling net in use. (Bickerdyke, J. 2011)



Figure 1. 3: Example of trawling damage through a wreck site.
(Odyssey Marine Explorations (www.wreckwatch.org)

After its initial find/discovery, there is an increased chance that a site will be revisited for the purposes of looting, particularly if the objects recovered from the trawl are regarded as being of economic value. Word of mouth will travel through local communities and illegal salvagers will visit a newfound wreck and try to make off with as much material as possible,

as quickly as possible.[65] With shipwrecks of this time period, ceramics are typically the most popular material that gets looted. They are generally the most numerous artefact type found on a wreck, have a relatively large value, preserve well in an underwater environment, have few conservation problems and are the easiest to identify and recover at a wreck site. Precious metals while highly sought after, are very rarely encountered on shipwrecks of this era.

Local underwater archaeology offices are often alerted to the presence of a shipwreck through the fishing crews that have encountered the wreck, whereby funds are allocated to conduct a survey of the site, initially to register the wreck site in shipwreck databases, and also to judge the feasibility of future excavation. Qualities like the condition of the wreck and the material; the danger of loss due to looting or through environmental degradation and logistical safety of excavation are taken into consideration to determine the practicality and necessity of excavating the shipwreck site. Funding for such endeavours may come from an annual excavation budget, through cultural heritage Foundations or amateur diving professionals. For example, in the United Kingdom, there are strict guidelines as to what designates a shipwreck site. Outlined in those guidelines are the best actions for conservation and protection on shipwreck sites found in UK waters.[66] Shipwreck management policies in Southeast Asian countries are varied. Stewardship over a wreck site is more commonly a reactive rather than proactive process. Excavation and survey crews are put together after fisherman or divers find a wreck, and only when budgets allow. Many of these countries enter into contracts with private companies or foundations, and negotiate the salvage, sale and conservation of the artefacts. However, there has been great improvement in shipwreck management by every country in Southeast Asia. Countries like Vietnam had no maritime archaeologists as of 2006, now it has several.[67] The Philippines has had a strong management policy on shipwrecks for nearly three decades, and continues to do so. The Underwater Archaeology Division in Thailand has expanded their conservation team as well develop an effective training program for new underwater archaeologists.

1.1.3.2 Purposive discovery of shipwrecks

[65] Usually, it is dependent upon the depth of the find, but illegal salvage operations have been documented to depths of nearly 60 meters. Goddio et al. 2002
[66] English Heritage 2012
[67] Flecker 2006

Funding for purposive discovery surveys are undertaken in a stretch of water where known shipwrecks are. The survey season can be from a week to 45 days to analyse large swaths of the ocean floor, conduct exploratory dives on possible sites and eventually determine whether or not such sites are fiscally worth excavating. For researchers, the ultimate gain is to document sites for further analysis. For salvagers, the main question is less about cultural heritage and more about whether the artefacts found would yield the monetary returns to fund the excavation as well as realise a profit for the company.

After artefact recovery, there is a further differentiation between those salvagers that sell the whole of the assemblage as one lot (in the case of the Bakau wreck and Seabed Explorations, and previously with the Beilitung wreck [68]) and those that sell an assemblage piecemeal to pay for the excavation and operating costs (some examples being the Vung Tau wreck,[69] the Hoi An wreck,[70] the Cau Mau wreck [71]). While there may be a greater academic advantage to the selling of an entire assemblage to a single buyer, such considerations are secondary to the economic imperative to make a profit. Consequently, if it is of greater commercial benefit to sell the assemblage as a whole this would happen although the number of potential buyers for such large and expensive cargoes is likely to be small. It is, however, more likely that the finds will be divided up into lots and sold at auction with all of the accompanying loss of information to the academic community.

1.2 Excavator Motivation and Publication

The archaeological sites in this case study have undergone a series of natural and anthropogenic transformations that have resulted in a wreck site that was excavated. 'Anthropogenic' here is normally used in terms of physicality: on land it could be ploughing a field or construction, while in an underwater environment it could be trawling damage, looting, or excavation. Trawling damage scattered the cargo of the Turiang and destroyed much of the upper layers of the wreck site.[72] Dynamite was used to blast through metal concretions of the Rang Kwien.[73] After the Lena Shoal was surveyed, the local community was told that the 'bones' they believed to be present onsite was in fact, ivory.[74] Between the time the site was surveyed and the excavation team arrived (about two weeks) a large amount

[68] Flecker 2001a; Krahl et al. 2010
[69] Christie's 1992; Flecker 1992a; Flecker 2005
[70] Butterfields 2000; Pope 2007
[71] Sotheby's 2007; Lamond 2008
[72] Brown & Sjostrand 2000, p.14
[73] Intakosai 1983
[74] Goddio et al. 2002, pp.12–13

of the ivory was illegally looted from the site.[75] The excavation of all of these wrecks represents the one-anthropogenic factor that ultimately destroys the site. How well the excavation has been documented depends upon the group that was conducting it. The hope for academic research is that while the site may be destroyed, enough data was collected to properly reconstruct the site. A company that salvages a wreck is usually less concerned with where things were located and where things settled. Excavation would be rapid, and concentrating on the more profitable cargoes rather than ship structure and rotted/corroded/unsellable cargo. There is also no guarantee that the material will be treated in a professional manner. Mike Hatcher's excavation of the Tek Sing is a perfect example of blatant disregard for archaeological context and artefacts. Ceramics recovered from the shipwreck were not subject to any conservation plan. The ceramics were simply piled up on the boat without any care for their condition (Fig. 1.4). [76]



Figure 1. 4: Ceramics recovered from the Tek Sing shipwreck. (Jim Railton, www.thejournal.co.uk)

Even after excavation, anthropogenic factors still affect the way in which we see certain artefacts through the publications. As Stephen Dyson says, "In archaeology [the post-depositional] process is much more complicated, since the archaeologist functions both as the "reader" [of the site and its artefacts], but also as the second author, who prepares a series of new texts which "give life to the past" and in turn require a new set of readers to give them meaning."[77] As this 'second author', the excavators' personal interest and prejudices, as well as their cultural and social-economic background shape much of the published material that they produce. However, there is also a mutual feedback exchange between the archaeologist

[75] Goddio et al. 2002, p.16
[76] Henderson 2014
[77] 1993

(as author) and the intended audience that the work is being written to. For example, as one moves from academic work (academic journal or book chapter) towards a more popular forum (coffee table book, magazine article, sale catalogue), the language, content, and even theory can change to address to a specific demographic. To be clear, more popular forms of publication are certainly not a 'bad thing' and indeed archaeologists need to communicate effectively with a wide variety of audiences if their work is not to remain in the ghetto of academic particularism with its numerically small interest groups. It is, however, up to this "new set of readers" to understand the sources that they are reading and assess them appropriately in terms of context, content and quality. Again, to quote Dyson,

> "[t]he image of the archaeologist as engaged in the calm, unbiased, scientific investigation of the past has to be balanced by a consideration of the ways in which biases and societal pressures, conscious or unconscious, have shaped and continue to shape the archaeologist's investigation and reconstruction of the past."[78]

This interpretation by archaeologists, however biased or unbiased, is made through the myriad of interactions that they experience with the artefacts that they are studying. The relationships that are formed between artefact and excavator are unique and dynamic and easily changed over time throughout its excavation and preservation, and the subsequent methods of publication.[79] Schiffer describes it in terms of "interactors"– a form of matter capable of interaction: people, artefact, or extern.[80] In the model applicable in this case study, the interactors form a behavioural system – "a set of interactions with a group of people over an interval of time" in the form of people (archaeologist) and artefact (excavation and interpretation); people (audience/readership) and people (archaeologist); then artefact (interpreted) and people (audience).[81] The artefact has an influence upon the archaeologist when found: what the artefact is, where it was found, the condition and quality of the artefact was found in, as well as why it might have been found at said site and at said location. The archaeologist has an interaction with the artefact: the condition of the artefact causes us to judge its importance, judge its survivability and infer the implications of its presence/absence.

As mentioned previously, Roxanna Brown and Sten Sjostrand excavated the Turiang. The relationship between the excavators and the objects are both academic and economic. Brown wished to analyse the artefacts. Sjostrand wanted to preserve the material, but the excavation

[78] Dyson 1993 As above.
[79] See Schiffer 1999, p.2; Meskell 2004, p.3
[80] Schiffer 1999, p.12
[81] Schiffer 1999, p.20

costs must be paid for. With no academic party able to fund the excavation, the decision was made to sell a percentage of the artefacts to pay for the excavation. I believe that Sjostrand was operating with altruistic intentions, yet pragmatic rationality. He and Dr Brown had a long working relationship, excavating the Royal Nanhai[82] and the Xuande [83] shipwrecks. The research on the Turiang is sound, excavated and surveyed expertly, and its publication is widely available, yet there is the capacity for a mistreatment of certain types of objects. Roxanna Brown was a ceramicist by trade. Her work was on the ceramics of Southeast Asia. Sjostrand's website only sells ceramics. It is possible that this interest in ceramics directly affect what was retrieved from the wreck.

The Underwater Archaeology Division in Thailand excavated the Rang Kwien wreck. It was used for training purposes, which has its benefits and drawbacks. Mistakes could be made and objects could be missed with inexperienced excavators, yet eager students are often more diligent and exacting, taking more time to make sure a site was well surveyed and properly excavated. The trainers from the UAD are authorities on underwater excavation in their own right, and there is no reason to think they did not do their jobs correctly. Many of the students who trained on the Rang Kwien are now veteran excavators and facilitators with the UAD. The plan for the artefacts of the Rang Kwien was for them to be housed at the UAD in Chanthaburi. The bulk of the assemblage is still there.[84]

The Bakau wreck was excavated by Seabed Explorations, under the leadership of Tilman Walterfang, whose relationship with the assemblage is rather complicated. Walterfang, a mechanical engineer turned underwater excavation investor believes that salvage work is a form of "triage". He believes that although his excavations might not be to a professional archaeological standard, there is a race to keep the artefacts away from the "looters".[85] Archaeological context is one of those attributes that get sacrificed for the sake of speed. After the initial survey of the site, the crew saw enough high quality material to deem the excavation profitable. Walterfang's motivation was an economical one. Because of this, the excavation was a rapid affair. Little care was made into drawing the wreck and its artefacts in situ; therefore we as researchers lose data on the wrecking process, lading practices and ship

[82] Sjostrand n.d.
[83] Sjostrand 1997
[84] Portions of the ceramic complement of the Rang Kwien have been donated to local museums in Thailand as a means of showing the history of trade and Thai products.Vatcharangkul 2013
[85] Walterfang n.d.

construction during that era. It is also possible that objects that looked less profitable, or objects that had no relation to the trade goods on the ship was purposefully overlooked.

At that time of the Bakau excavation, the UNESCO Convention on the Protection on Underwater Cultural Heritage was not enacted, and the international sale of shipwreck artefacts was legal. Hence, after the Bakau wreck was excavated, it was legally sold to a resort and museum outside of Indonesia. While Walterfang's prime motivation might have been for profit, he recognized the necessity to keep the assemblage whole. He acknowledged the necessity for research and to break up the assemblage would have ruined any notion of studying the assemblage as one whole grouping. Whether he was sincere in this opinion, or whether this was move to give the project a veneer of respectability, is unknown.

The UAD and members of the Australasian Institute of Maritime Archaeology (AIMA) excavated the Ko Si Chang III. The site was excavated strictly for academic purposes; therefore the whole assemblage was recovered and kept together in Chanthaburi, Thailand. Since there is no bias toward any one type of artefact, the motivation is to excavate the whole of assemblage in order to understand the diversity of trade products on board.

The Lena Shoal was a shared excavation between FEFNA and the National Museum of the Philippines. Goddio's interest was not an economic one. The deal made on the excavation was that FEFNA and the HILTI Foundation would take 50 per cent of the artefacts (chosen by the National Museum) and house them; with the intention to establish a Maritime Museum in Europe. The artefacts would never be sold, and be accessible to the public for education purposes. The excavation was thorough and professional. The National Museum's motivation was to preserve the cultural heritage of the Lena Shoal.

The Santa Cruz excavation was undertaken in the same way as the Lena Shoal. It was a cooperative effort through FEFNA and the National Museum of the Philippines with the artefact assemblage to be split 50-50 (again chosen by the National Museum).

1.2.1 Motivation through publication

After the excavation and initial conservation, there is a subconscious interaction between the archaeologist and the audience that they wish to convey the data to. An academic press would publish the whole archaeological excavation report, knowing that the academic community that the press reaches would respectfully appreciate the detailed excavation and inventory along with the day-to-day minutiae of the project. A report with a more mainstream

readership in mind might only write about the photogenic objects, or those that have intricate cultural designs, or interesting stories associated with them. A sale catalogue would cater to the art connoisseur, discussing the artefacts in terms of style, taste and manufacturing pedigree. The resultant narrative is consequently dependent upon its intended audience. For example, the wreck of the Ko Si Chang III was published by the Australian Institute of Maritime Archaeology (AIMA). All of the artefacts were addressed in that body of work, from an objective point of view.[86] Goddio's motivation behind the Lena Shoal publication comes out of a drive to show the wider public the results of excavations at an "art" venue, so ceramics were stressed. [87] Other objects did not benefit the catalogue, and the story behind the wreck of the Lena Shoal was played down.

After the work is published, the intended (or unintended) audience perceives the published material in the manner with which it was conveyed. An art connoisseur reading a glossily illustrated 'coffee table' book on the ceramics from a shipwreck would reinforce the trope that ceramics are fetishized and that they define trade patterns in Southeast Asia, causing a desire for more of the same. The prioritization of these artefacts causes a feedback loop, compelling excavators to publish studies on the objects that the larger public has a greater affinity for. This observation is not a criticism. With academics and ceramicists, it is a step to make archaeology more accessible, or to work within the confines of what is appropriate to write about. In the case of treasure hunters, it is a case of knowing what their niche market is — intact ceramics and the good stories that go with them.

It is unlikely that the same connoisseur would consider reading an archaeological report in a journal. However, to be exceptionally knowledgeable about your subject, it is necessary to read all types of published works on an area of study. Just as connoisseurs should read archaeological reports to better understand the art that is being appreciated, the archaeologist should read less academic works in order to appreciate the necessity for such books as well as competently glean the technical information that the author is holding back from the wider audience. Archaeologists have to be critical of these works, but not to judge them as "bad" or "good" for the scientific method. They are all "good" because we as the reader understand the interactions taking place in the content. It is important to recognize the intended audience of a published work in order to question its content. We can answer the questions of, "What kinds

[86] Green et al. 1986
[87] Goddio et al. 2002

of interactions are taking place between interactors?" and "By what rules are these interactions governed?"[88]

An artful literary work interacts by catering to its audience. This is governed by the rules of aesthetics. Art is emotionally profound and people appreciate it because of this: books about art sell. The narrative of the shipwrecks may be skewed in these circumstances, but there are general truths surrounding the material. Those artefacts deemed "less aesthetically pleasing" play a supporting role in telling the shipwreck narrative.[89] This is due to the lack of study on them, a lack of popular aesthetic interest, and simply a lower frequency of physical finds. These social and aesthetic concepts of fetishized objects must then be questioned in order to challenge existing ideas of the object-observer experience.[90]

It is in these emotions that we all, archaeologists and non-archaeologists alike, ascribe relationships to material culture and set up a hierarchical rubric of aesthetics.[91] All of the artefacts described in this thesis are old and have an historical connection. Nevertheless, ceramics have a more 'definite' history because of their widespread popularity (both in the past and the present) and a higher 'visibility' in the literature; therefore they merit having a higher social value.[92]

1.3 Discussion

This case study comprises of six shipwrecks. Three of these ships (Turiang,[93] Rang Kwien, [94] and the Bakau [95]) are built in the Chinese tradition: with hardwoods local to China and Northern Vietnam, using iron nails, and having a series of spaced watertight bulkheads. The other three (Ko Si Chang III, [96]Lena Shoal,[97] and the Santa Cruz[98]) have been identified as Southeast Asian "hybrid-style" junks, built with softwoods local to Southeast Asia and using wooden dowels instead of iron nails.

[88] Schiffer 1999, p.8
[89] Schiffer 1999, p.82
[90] See Meskell, 2004, p.2.
[91] As described in Gosden 2004.
[92] See Meskell, 2004, p.21
[93] Brown & Sjostrand 2000, p.8
[94] Intakosai 1983
[95] Flecker 2001b
[96] Green et al. 1987
[97] Goddio et al. 2002, pp.22–26
[98] Orillaneda 2008a; Orillaneda 2008b

All of the literature on these wrecks surmise that these ships had either been to, or picked up wares from the three largest ceramic production centres in the region: China, Vietnam, and Thailand. The ceramic material tells a solid narrative pertaining to where these boats are coming from and hints as to where they were going.[99] For example, the Bakau is a Chinese ship, wrecked off the coast of Indonesia. It is suggested that the ship had passed Vietnam and Thailand already, as it possessed both Thai and Vietnamese wares in its assemblage. Flecker then assumed that the Bakau had loaded the Chinese ceramics in China, dropped some off in Vietnam, thereby loading some Vietnamese wares, and in Thailand picking up Thai ceramics.[100] The Lena Shoal and Santa Cruz are both Southeast Asian hybrid designs. The assumption here is that these ships, originally loaded with Thai material, travelled to China to offload their wares and load up on Chinese ceramics, hence the high quantity of Chinese ceramics on board both ships. Other trade goods were found on these vessels but the voyaging narrative is reconstructed only with the ceramics. If any other artefacts were taken into account (e.g. tin ingots), it would expand the interpretation of the voyage. This then leads to the idea of needing to do it systematically for all materials. This scenario begs the question of how the narrative might change if we incorporate more of the archaeological material, in particular the non-ceramic finds?

Historically, these shipwrecks represent part of a network of trade routes that reached throughout maritime Asia and Australasia; its main flow pattern running back and forth between the southern Chinese ports of Hangzhou (杭州), Guangzhou (广州) and Quanzhou (泉州), through the South China Sea and into the Indian Ocean, eventually leading to Near Eastern cities of Jeddah and Hormuz, as well as African ports like Fustat (modern Cairo).[101] While ceramics made up a large part of this network, trade routes did not just transport ceramics. Hundreds of other trade goods shared the cargo holds and decks of the ships in this network and yet they so often fail to be incorporated into the historical narrative. For example, China was trading in materials other than ceramics; commodities like silks[102] and copper coinage.[103] Throughout mainland Southeast Asia, there are successful markets trading in camphor, textiles, gums and resins, and aromatic woods,[104] while the archipelago of

[99] This will be discussed in greater detail in Chapter 2.
[100] Flecker 2001b
[101] Elisseeff 2000; Lobell 2010; Fahy 2010; Guan 2010; Craig A. Lockard 2010
[102] Carswell 2000, pp.12, 17
[103] Intakosai 1983
[104] Hirth & Rockhill 1911, p.67

Indonesia also profitted from the trade in tortoise shell, Javanese silks, cardamom, pepper nutmeg, feathers, bird and coral.[105]

Most of these items would normally be lost or degrade completely in a shipwreck, yet some have survived from the assemblages recovered from the wrecked ships in this thesis. Some objects were scantily reported in their publications and in some cases nothing was mentioned in the written material. When we incorporate these other items the narrative broadens out to reveal a larger web of interaction. Existing ceramic markets become more pronounced, because they do not simply trade in one commodity. Peripheral markets also begin to appear; ones that may not have had a strong ceramic tradition but had material to contribute to the trade network. To fully observe the interconnected nature of the whole assemblages, we must adopt a Kopytoffian understanding of all classes of excavated objects. In his assessment of commodities, Kopytoff promotes the idea that objects and artefacts are not isolated. The objects found share an interconnected network of relationships with each other and with those that interact with them.[106] I will show that the artefacts in these assemblages share a number of relationships between each other and how a more holistic approach to the assemblages establishes a more nuanced narrative. This will be discussed in greater detail within each chapter.

The artefacts, when investigated as a whole, will tell a more complete story about trade during the 14th and 15th Centuries. Yet, we can also understand the connection to the narrative through the people involved in these excavations. By understanding the motives behind the excavation, we can better understand why these ships were interpreted and published the ways that they were. By interpreting academically excavated wrecks, collaborative private/public excavations and salvage excavations, a dialogue can be started to carefully assess the advantages and disadvantages of each approach to excavation as well as to their publications.

This represents an opportunity to study the assemblage outside of the ship. Analysis of a ship's construction can tell us a number of important things; technical knowledge in nautical engineering, ship features and ship type, wood type and (with subsequent analysis) possible area of construction. During excavation, while underwater, these things need to be investigated while you are on site, especially if there are no plans for the extraction and

[105] Wade 2009
[106] Kopytoff 1986; Meskell 2004, pp.55–56

conservation of a ship's timbers. If the choice is to leave the timbers in situ, archaeologists need to extract as much data as possible. There is an inference made about the type of ship construction that likely attaches the ship (therefore some of its contents) to the region that it is manufactured (e.g. a Chinese built junk is from China, a Southeast Asian hybrid style is from Southeast Asia). This premise is statistically likely, yet we are truly unaware of the motivations and machinations surrounding the life of the ship. A ship built in one country can be sold to another, or captured and conscripted into another country or pirate entity. The ships do hold valuable information and statistically, a base frame of reference for 'home port' in the regional sense, but objectively it is an unknown.

By studying the assemblage separately from the ship, we leave that objectivity behind and glean the potential nature of the archaeological assemblages as evidence. We can delve into detail about what products seem likely to be tradable commodities, or which material represents everyday life on the ship. It can pair types of resources and products with localised ceramics in the hopes of creating a more diverse network of trade and shipboard life. We know a great deal about ceramics, ceramic centres their common emporia. We can analyse the non-ceramic material and geographically allocate them to give these emporia a more well rounded appearance.

We will first turn now to the evidence from ceramics which allows us to get an initial impression of the trading networks before moving on to look at portions of the cargo that are not generally looked at. The structure of the chapters is through a consideration of material type – ceramics, metals, organics, etc. – then considering more functional categories within these broad classifications. By analysing all of these materials within the assemblages in better detail, I hope to show that while some of these reports are far from ideal, there is a lot of opportunity to move these projects towards a better 'state of the art'.

2.0: Ceramic Assemblages

2.1 Introduction

The goal of this chapter is to highlight the ceramics found within each shipwreck assemblage in order to gain a better understanding into the nuances that they portray between other types of objects as well as within the medium itself. The chapter is designed to give a baseline of shipwreck narratives to begin from, as reflected through the published material. Even simply focusing on this baseline narrative, it reveals bias between different types of ceramics.

Scholarly literature often portrays that Chinese trade ware porcelain overshadows all other artefacts. Other regional production centres have largely been written out of large-scale maritime trade, yet many of the shipwreck cargoes examined in this thesis contain abundant evidence for Thai, Vietnamese, and Burmese ceramic production. Consequently, an aim of this chapter is to reclaim the importance of both regional wares, as well as the material that coarse trade wares may have contained. The ships in this thesis and their cargo represent a more complex and exciting pattern than ones that simply look at China and porcelain.

The maritime economy in Southeast Asia has largely revolved around the ceramic trade since ancient times.[107] Ceramics have been present to varying degrees in ships' holds, along with an array of heavy material used as ship's ballast. If the ship was not heavily laden with metals, then an equal amount of stone was usually used as buoyancy corrective.[108] With Southeast Asian shipwrecks, we find a mixture of ceramics and stone ballast in twelfth and thirteenth century shipwrecks;[109] in the fourteenth century we see a shift from this hybridized ballast to a one strictly made-up of ceramics and other heavy tradable cargo. It is likely that this shift transformed cargo in the region from simply being a necessary safety into an added economic boon for international traders. Instead of carrying materials like stone in their holds, materials worth little or no value, holds could be literally crammed with high quality, manufactured goods that served the same ballasting purpose but could also be sold.[110] In this case, ceramics in high volume made the perfect ballast for a merchant vessel.

Most assuredly, perishables like grains, spices, and water were transported in these ships as well. In the Mediterranean during the Roman era, grain was loaded into burlap sacks and distributed across the empire,[111] however, in medieval South and Southeast Asia, rice was

[107] Flecker 2001a
[108] McGrail 2004, p.52
[109] Orillaneda 2014a
[110] McGrail 2004, pp.223–4
[111] Rickman 1980

transported in ceramic containers.[112] By assessing the wide reaching spread-patterns of earthenware vessels that contain perishables from Southeast Asian shipwrecks it is assumed that is was a common practice of keeping these types of on the decks of these vessels.[113] While a portion of these items was probably allocated to crew stores, most were undoubtedly traded as a commodity.[114] Due to the nature of the excavation environment, the preservation of such perishables is fleeting at best. Unlike Classical Mediterranean excavations, where there are gaps in the distribution of cargo due to the decomposition of the perishable elements of the cargo, the ceramics from Southeast Asia remain preserved although their contents often are not.[115] Therefore, most underwater excavation reports rely heavily on the ceramics in a wreck, since the durability of these items gives them a high survival rate over time in a high-salinity, aquatic environment.

In this chapter, a proportional makeup of the ceramics from each case-study shipwreck is illustrated. An exact inventory count of the ceramic assemblages for each ship is given in Appendix 1.[116] I will note what was found on each ship, including the different types and regions that the ceramic assemblages are comprised of, then discuss what the material says about artefact bias as well the challenges surrounding the study of the ceramic parts of the cargoes of wrecked ships from Southeast Asia.

2.1.1 Ceramic research methods in Southeast Asian archaeology

In order to understand and interpret the ceramic portions of the cargoes, we require a brief background into the main analytical methods that have been used in their analysis. There are many different types of ceramic analyses that are suitable for a variety of research questions. Ceramics can be described in terms of function and use, by experimentation and ethnographic study, or discussed in terms of their aesthetic and style. Pottery can also be analysed by its composition, its production and manufacture and through its distribution and exchange patterns. Prudence Rice and Clive Orton have expertly defined these methods.[117]

[112] Brown & Sjostrand 2000; Green et al. 1987
[113] Sjostrand & Barnes 2001
[114] Reid 1993, p.2
[115] See Rice 2011
[116] Counts are based upon the published material, or from the actual inventories. Any inconsistencies in counts will be noted and annotated, with the best estimates given.
[117] P. M. Rice 1996; P. Rice 1996; Orton et al. 1993

Different types of analysis can be used individually (e.g., a case study on the ceramic motifs on blue-and-white ceramics) or can be combined (e.g., using said ceramic motifs to determine places of production or discuss the meanings behind them) dependant upon the research questions being asked. In the early years of ceramic study, a classification type methodology was routinely used and identification of ceramics through seriation and chronology was conducted.[118] Only within the last few decades has a more processual or post-processual analysis been employed in the study of Southeast Asian ceramics.[119] Combining both the traditional typological approach as a first step in an analysis, with more recent analytical post-processual perspectives is the most appropriate way of studying the ceramics from the shipwrecks in this case study.

Traditionally, scholars have either worked on Chinese export wares or the regional ceramics of Southeast Asia. For example, Roxanna Brown[120] and Dawn Rooney[121] conducted general studies of identifying the ceramics of mainland Southeast Asia, while Monique Crick[122], Rose Kerr[123] and Regina Krahl[124] have conducted similar studies with regard to the Chinese export wares found in the region. Only rarely have authors such as John Guy compiled material from both ceramic centres.[125] Furthermore, Crick, Kerr, and Krahl take an art-historical perspective to study the Chinese export ceramics via a stylistic and connoisseurship approach, whereas Brown, Rooney, and Guy combined a stylistic analysis with the archaeological research into Southeast Asian kiln sites in order to understand what material is coming from which kiln sites at certain times.

The difference in methodology in studying the two ceramic centres is understandable. Firstly, we are discussing export wares from one region (China) with the intra-regional ceramics of another (Southeast Asia). The case for sourcing certain ceramics is less stressed when you are discussing them through an art-historical perspective, and from the viewpoint of an export market. Through meaning and motif, it is less imperative to understand where these ceramics are being made. It is more important to interpret whether certain motifs and forms commonly populate specific trade markets.

[118] P. M. Rice 1996; Orton et al. 1993, pp.3–22
[119] Barretto-Tesoro 2003; Rooney 1996; Knappett et al. 2012; Brown 1988
[120] Brown 1977
[121] Rooney et al. 2010
[122] Crick 2009
[123] Kerr et al. 2011
[124] Müzesi. et al. 1986; Krahl et al. 2010
[125] Guy 1986; Guy 1989

The kiln sites in China are well known through both archaeological and historical research, while the kiln sites in Southeast Asia are less so. Chinese celadon during this period is produced at the Longquan kilns in Zhejiang province, [126] while the Ming blue-and-white wares are universally manufactured in Jingdezhen.[127] Compared to Chinese kiln sites, much less research has been published on the kiln sites in mainland Southeast Asia, and there is little to no written record of the Southeast Asian ceramic tradition. A combined methodology helps in this situation, because the Thai, Khmer, Burmese and Vietnamese ceramics vary stylistically in form and decoration, as well as in the geochemical makeup of their respective sources of clay. [128]

Only recently has there been technological studies on the glazes and clay bodies of Southeast Asian ceramics. The microstructure and composition of Vietnamese ceramics have been analysed using a multitude of material science techniques. Chemical analysis, scanning electron microscopy, Energy Dispersive X-ray spectroscopy (EDX, EDS) analysis, X-ray diffraction, Raman spectroscopy, thermal expansion/shrinkage and open porosity measurements were conducted on Vietnamese sherds.[129]

This research is aimed at understanding why there are so few Vietnamese ceramics in most exported terrestrial and shipwreck assemblages. There is a growing question into whether or not we are identifying Vietnamese ceramics correctly. The same holds true for Southeast Asian celadons; It was generally assumed that these were products made exclusively in Thailand, yet emerging research into Burmese kiln sites are changing that theory.[130]

Studies on the glazing composition and techniques of Thai and Vietnamese ceramics have been conducted using Raman spectroscopy, EDX, X-ray fluorescence, thermal expansion/shrinkage measurement and scanning electron microscopy. [131] Michael Tite[132], Nigel Wood [133] and Wen Rui [134] conducted similar technical studies on the glazes and pigments of Chinese ceramics.

[126] Li 1996, p.137
[127] Li 1996, p.144; Carswell 2000, p.15
[128] Liem et al. 2002; Colomban et al. 2003; Colomban et al. 2004
[129] Colomban et al. 2003
[130] Orillaneda 2008c; Brown 2009, p.185
[131] Sagon et al. 2004; Simsek et al. 2014
[132] Tite et al. 1984
[133] Wood 1999
[134] Wen et al. 2007

As ceramic studies evolve over the years, we begin to see a more comprehensive research using a combination of methodologies. Scientific analyses were being incorporated to date kiln sites, in order to understand the rise and fall of ceramic traditions on mainland Southeast Asia.[135] Roxanna Brown used form and stylistic analysis to achieve similar aims.[136] Miriam Stark has used ceramic technologies like clay analysis, geomorphology and petrography to discuss its social variability through ethnography between communities in the Philippine highlands.[137] In my master's thesis, I discussed the social life of blue-and-white porcelain in the 14th and 15th Centuries and how it takes on different social attributes inside and outside of China.[138]

It is important here to differentiate between the archaeological excavations of kiln sites and the investigations of ceramics. Kiln sites can give us provenance, and can be associatively dated in accordance with other finds. Ceramics on the other hand, unless they are found within an excavation, have no provenance and cannot be properly dated archaeologically. They can be dated based upon stylistic patterns in a broad sense. Because of this, many Southeast Asian production dates have been re-assessed due to archaeologically-based excavations.

Detailed research into maritime trade is also somewhat new in the region. Shipwreck excavations have been conducted since the late 1970's. Most of the published material during this early period were comprised of a rough typology of artefacts; more focus was put upon materials found that specifically pertained to boat construction (when said material was found in a site). This was vital to the understanding of Early Modern seafaring in Southeast Asia. Pierre Yves-Manguin developed his theory on a hybridized Southeast Asian junk, which allowed future underwater archaeologists to put their shipwrecks into a better perspective. Archaeologists like Jeremy Green, Erbprem Vatcharangkul and Eusebio Dizon developed sound underwater archaeological techniques and a generation of strong, competent underwater archaeologists.

Researchers started publishing their shipwreck excavations, which began to paint a picture of the scale of the maritime trade throughout the South China Sea interchange over several

[135] Grave et al. 2014; Hein 2008; Barbetti & Hein 1989
[136] Brown 2009
[137] Stark et al. 2000
[138] Fahy 2010

hundred years.[139] Through this, studies of the maritime economy, trade and politics of Southeast Asia were produced, by interpreting historical sources and the archaeological record giving a more comprehensive understanding of the scope of seafaring between the Far East and the Indian Ocean.[140]

Several shipwreck catalogues have been published, with an aesthetic slant towards the ceramics that they were carrying.[141] This combination of published catalogues, shipwreck articles and historical analysis material allow for a more complete critique on the ceramic trade in the region. Works by Miksic [142] and Witkowski[143] show the footprint and popularity of the medium from an archaeological perspective.

The pedagogy of ceramic research is rich and extremely vital in the understanding of ceramic trade in the region. However, the research method has been around long enough to be able to critique it. I accept that research is variable in both the methods used and the places they are applied. Nevertheless, there is a body of scholarship that can be drawn upon to understand the ceramics on the ships in this case study in terms of where they come from and when they are dated to. I believe that the study of these ceramic assemblages reveal opportunities in discussing new methods of interpretation. There also seems to be several biases that reveal themselves in this archaeological study that need to be addressed.

2.2. Ceramic corrosion in an underwater environment

Ceramics are found in varying states of preservation in an underwater environment. Some high-fired porcelains and stonewares have the potential of being found in excellent condition, despite being covered in marine concretions. Typically, poorly glazed ceramics or ceramics with no glazes deteriorate rapidly in a similar environment.[144] Breakage appears to be the most common form of deterioration in a shipwreck site. This can be due to the initial wrecking of a ship on the sea floor, or through the disturbance of sediment through a site via wave action, vessel decay, or trawling.

Glazes seem to offer some level of protection for the clay body against the destructive agents in this environment. The salt or the sand first needs to breakdown the glaze before it affects

[139] Green et al. 1987; Intakosai 1983; Intakosai 1984; Flecker 1994; Flecker 2001b; Flecker 2002a; Sjostrand & Barnes 2001; Brown & Sjostrand 2000
[140] Reid 1993; Bulbeck et al. 1998; Hall 2011; Ptak 1994; Ptak 1998; Ptak 1999
[141] Krahl et al. 2010; Goddio et al. 2002
[142] Miksic 2007
[143] Witkowski 2013
[144] Pearson 1987, p.100

the clay body. Salt breaks down glazes in a similar manner to breaking down glass, via ion transfer. The network structure of glazes (and glasses) is silica, with modifiers of aluminium, calcium and magnesium. If there is enough room in the structural latticework (i.e. if the modifier quantities are not large enough to create a decent barrier), sodium and potassium ions move to the surface of the glaze and allow hydrogen ions to permeate the latticework. The hydrogen ions will produce hydrated glass and slowly break up the silicate layers within the lattice. These layers then flake off, taking with it the ionized sodium and potassium. New sodium and potassium ions will then attach themselves to the newly exposed layer of glass (or glaze) and the cycle begins again.[145]

2.3 Ceramic inventories of the case study assemblages

The goal of this section is to go thorough the ceramic cargo in each of the case study ships to outline the main types of ceramic on board and where they come from and provide a preliminary interpretation of what the ceramics tell us about the trade route. This will be subsequently developed in each succeeding chapter as new data is considered.

2.3.1 Early Ming Wrecks

Turiang (1370-1400CE)

The Turiang yielded approximately 1200 intact or nearly intact ceramic vessels, along with the recovery of so many ceramic sherds that a final tally of the ceramic assemblage puts the vessel count nearly 6500 pieces.[146] Thai ceramics dominate the ceramic assemblage of the Turiang. Approximately 3000 underglaze plates, bowls and jars from the Sukothai kilns are



Figure 2. 1: Underglaze Sukothai ware. (Brown and Sjostrand, 2000, pg. 26)



Figure 2. 2: Green-glazed Sawankhalok ware. (Brown and Sjostrand, 2000, pg. 30)

[145] Weier 1974; Pearson 1987, p.102
[146] Brown 2009, p.39; Sjostrand 2001

in evidence (Fig. 2.1), along with nearly 700 Si-Satchanalai (Sawankhalok) pieces. These comprise a combination of green-glazed wares (Fig. 2.2), blackish-brown glazed wares (Fig. 2.3) and underglaze decorated vessels (Fig. 2.4). A small representation of martaban storage jars from Suphanburi is also present (Fig.2.5). Local Thai earthenwares on the boat (Fig 2.6) supposedly contained rice, water and other crew provisions.[147]



Figure 2. 3: Black-glazed Sawankhalok ware. (Brown and Sjostrand, 2000, pg. 29)



Figure 2. 4: Underglaze Sawankhalok. (Brown and Sjostrand, 2000, pg. 28)



Figure 2. 5: Martaban Jar from Suphanburi kilns. (Brown and Sjostrand, 2000, pg. 37)



Figure 2. 6: Thai Earthenware jar. (Brown and Sjostrand, 2000, pg. 38)

[147] Brown & Sjostrand 2000, p.14,18; Sjostrand & Barnes 2001

Chinese ceramics on the ship constituted celadon ware (Fig. 2.7), brown glazed storage jars (Fig. 2.8) and monochrome pieces. Lastly, a complement of 500 underglaze black bowls manufactured in Vietnam makes up the remainder of the ceramic assemblage (Fig. 2.9).[148]

It is particularly interesting to note that all of the Thai wares that had remained within the wreck body were loaded homogenously in their own bulkheads, while the Chinese and Vietnamese shared bulkheads.[149] This could suggest that the Chinese and Vietnamese materials were loaded together, yet a more likely scenario was that the Turiang rearranged the remainder of their cargo to incorporate the Thai wares. Some of the Chinese and Vietnamese ceramic cargo was offloaded in Thai ports, and the remaining material was stowed together to fit into the bulkheads. Admittedly, this would be a time consuming process, yet since we have less evidence of emporia-based trade than a tramping-based model, this is my interpretation. The bulkheads that were filled with Thai material could then be left closed for the remainder of the voyage, if the Thai material was going to China. It was a case of efficiency. It is possible that the Chinese and Vietnamese ceramics on the Turiang were always intended to be used as tradable currency, therefore that material was never planned to be brought back its home port.

[148] Brown & Sjostrand 2000, p.17, Fig. 5
[149] Brown & Sjostrand 2000, p.14



Figure 2. 7: Chinese Celadon from the Turiang. (Brown and Sjostrand, 2000, pg. 35)



Figure 2. 8: Chinese brown-glazed jar. (Brown and Sjostrand, 2000, pg. 33)



Figure 2. 9: Vietnamese bowls. (Brown and Sjostrand, 2000, pg. 31)

The proportional representation of the ceramic material from the Turiang wreck is illustrated in Figure 2.10:

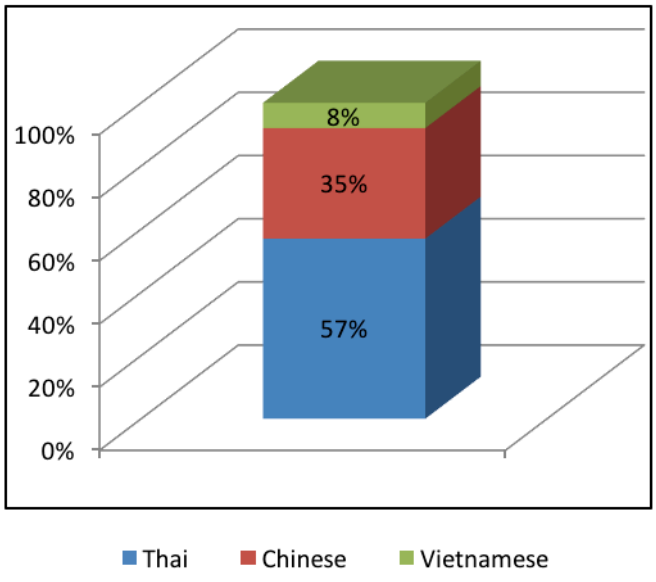


Figure 2. 10: Turiang Ceramic Makeup (by percentage)

Bakau (1410-1430 CE)

Both Brown[150] and Flecker[151], through local contacts, managed to obtain an unpublished catalogue of the excavated material from the wreck, which was produced by RMBH/Seabed Explorations after its initial looting. They reclaimed some of the purported material looted by local fishermen to fill in the gaps as to what was removed from the wreck prior to proper excavation. The unpublished catalogue consists of over twelve hundred ceramics from the site, with the possibility of several hundred ceramics removed beforehand. Since the looted objects cannot be accurately associated to the site itself, they are not used here as part of the ceramic assemblage of the Bakau.

The largest in-situ portion of the cargo on the wreck was a series of large Thai stoneware storage jars likely manufactured in Suphanburi province (Fig. 2.11). Other Thai pieces include: brown-glazed jars (Fig. 2.12), celadon jars and jarlets (Figs. 2.13, 2.14), and underglaze black plates from the Sawankhalok kilns (Fig. 2.15). Chinese ceramic material from the wreck consisted of celadon (Fig. 2.16), white-glazed wares and brown-glazed wares, along with some brown slip jars. Vietnamese monochrome (Fig. 2.17) and underglaze blue wares (Fig. 2.18) were also present. Earthenware jars and kendis (Figs. 2.19, 2.20) were also catalogued in the inventory.

[150] 2009, pp.36, 42
[151] Flecker 2001b



Figure 2. 11: Thai stoneware storage jars. (Brown, 2009, pg.111)



Figure 2. 12: Thai Sawankhalok brown-glazed jars. (Brown, 2009, pg. 108)



Figure 2. 13: Thai green-glazed jar. (Brown, 2009, pg.107)



Figure 2. 14: Thai green-glazed jarlet. (Brown, 2009, pg. 108)



Figure 2. 15: Sukothai underglaze black ware. (Brown, 2009, pg. 109)



Figure 2. 16: Chinese celadon bowl. (Michael Flecker)



Figure 2. 17: Vietnamese monochrome ware. (Brown, 2009, pg.112)

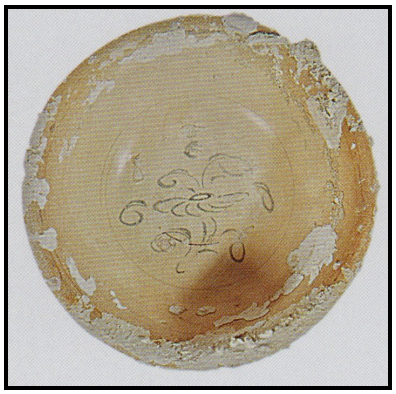


Figure 2. 18: Vietnamese underglaze blue ware. (Brown, 2009, pg. 112)



Figure 2. 19: Earthenware jar. (Michael Flecker)



Figure 2. 20: Earthenware Kendi. (Michael Flecker)

While conducting further research into the ceramics of the Bakau, there appears to be some confusion as to the provenance of the earthenwares found in the assemblage. Flecker[152] and subsequently Brown [153] state that many of the earthenware artefacts from the Bakau wreck are of unknown origin. The inventory obtained by Angie Liow from the Experiential Museum,[154] identifies all of the earthenware ceramics as "Thai". Ms Liow reported that a ceramicist with the National Museum of Singapore, re-analysed the material and deemed the earthenwares as coming from Thailand. [155] The underglaze black ware was simple to corroborate as being from Thailand. The material found on the Bakau wreck (Fig. 2.15) is nearly identical to the underglaze black ware from the Turiang (Fig 2.1), which was previously identified as such (being from Sukothai kilns) by ceramicist Roxanna Brown. Since this "reclassification" was conducted more recently, I decided to utilize this data as opposed to Flecker's' initial article on the wreck. Therefore, the proportional representation of the ceramic assemblage of the Bakau then is illustrated in Figure 2.21:

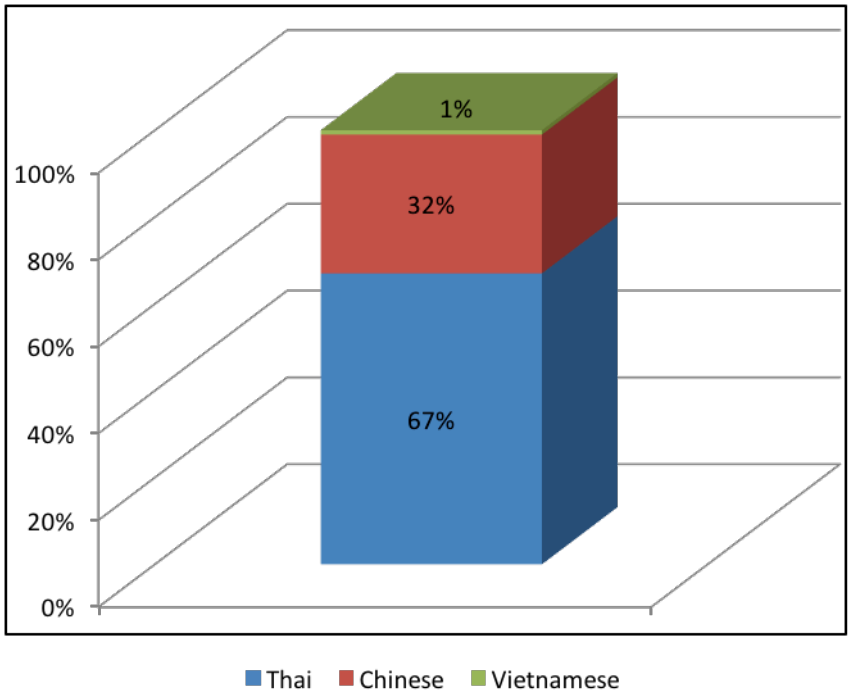


Figure 2. 21: Bakau Ceramic Makeup (by percentage)

[152] Flecker 2001b
[153] Brown 2009, pp.183–185
[154] Liow 2013
[155] Liow 2013

The in-situ jars prove their use as storage containers. When the sediment was removed from within the jars, two of them yielded organic material.[156] This has been analysed and will be discussed in Chapter 4.

Because this ship was commercially treasure hunted, there is no evidence for packing in the reports, making it difficult to speculate on the type of trade and routes that were taken.

Rang Kwien (1400-1430 CE)



Figure 2. 22: Vietnamese monochrome ware. (Brown, 2009, pg.89)



Figure 2. 23: Vietnamese blue-and-white ware. (Brown, 2009, pg. 94)

[156] It was not recorded or published as to which storage jar the material was removed from, or where on the wreck site these were found.



Figure 2. 24: Thai brown-glazed jar.
(Brown, 2009, pg. 84)



Figure 2. 25: Thai celadon ware.
(Brown, 2009, pg.85)

The ceramic material excavated includes monochrome ware (Fig. 2.22) and underglaze blue (Fig. 2.23) wares from Vietnam; brown-glazed jars (Fig. 2.24), green-glazed wares (Fig. 2.25), and a large amount of earthenwares (Fig. 2.26) from Thailand; along with a small amount of Chinese celadon (Fig. 2.27). Again, as with the Bakau wreck, there is a small discrepancy between the published work by Brown on the Rang Kwien[157] and the recent inventory of the Underwater Archaeology Division (UAD) in Thailand. Brown reports that underglaze black wares from Vietnam were a part of the assemblage, yet the UAD has no inventory of this material. Brown also identifies the blue-and-white material in the assemblage as Chinese, yet the current inventory of the items identify all of the blue-and-white on the Rang Kwien as coming from Vietnam. The Rang Kwien inventory was recently re-catalogued by the UAD in 2012. Based upon this reassessment as well as the material that I personally have seen, this reclassification seems more likely and is used here.

[157] Brown 2009, p.88



Figure 2. 26: Thai earthenware. (Underwater Archaeology Division, Thailand)

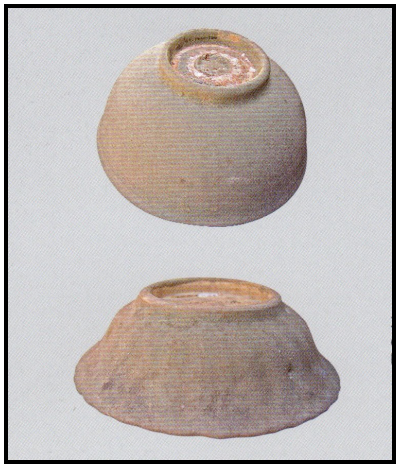


Figure 2. 27: Chinese celadon ware. (Brown, 2009, pg. 92)

Nearly 300 ceramics were recorded from the Rang Kwien shipwreck. The proportional breakdown of the ceramic portion of the cargo for the Rang Kwien is illustrated by Figure 2.28:

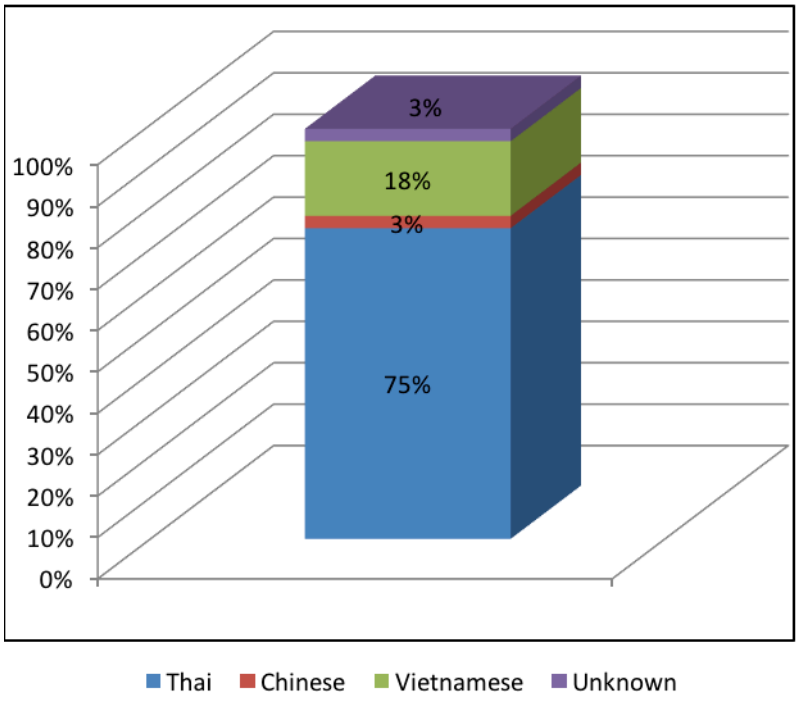


Figure 2. 28: Rang Kwien Ceramic Makeup (by percentage)

2.3.2 Middle Ming Wrecks

Ko Si Chang III (1450-1487 CE)

Approximately 300 intact or nearly intact pieces was recovered from within the Ko Si Chang III's hull. Wares found on the ship included: Blue-and-white wares from Vietnam (Fig. 2.29), blue-and-white wares (Fig. 2.30) and celadons from China (Fig. 2.31), as well as earthenwares, celadons, brown wares (Fig. 2.32) and underglazed material from Thailand.



Figure 2. 29: Vietnamese blue-and-white. (Brown, 2009, pg. 145)



Figure 2. 30: Chinese blue-and-white. (Brown, 2009, pg. 145)

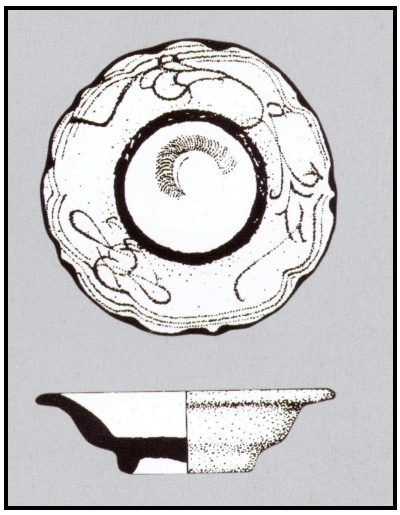


Figure 2. 31: Chinese celadon. (Brown, 2009, pg. 145)



Figure 2. 32: Thai brown ware. (UAD)

The cargo tended to "follow bulkheads", meaning that in each bulkhead identical forms shared bulkhead berths, and items were separated by region, with Thai ware in one bulkhead,

Vietnamese in another and Chinese in yet another.[158] Thai earthenwares were separately stored from stonewares, and the stonewares were divided between bulkheads into large (jars) and small types (plates, bowls, jarlets, etc.). These larger stoneware jars were situated upright in their respective hold, surrounded by lead ingots. [159] The proportional breakdown of the ceramic complement of the Ko Si Chang III is illustrated in Figure 2.33.

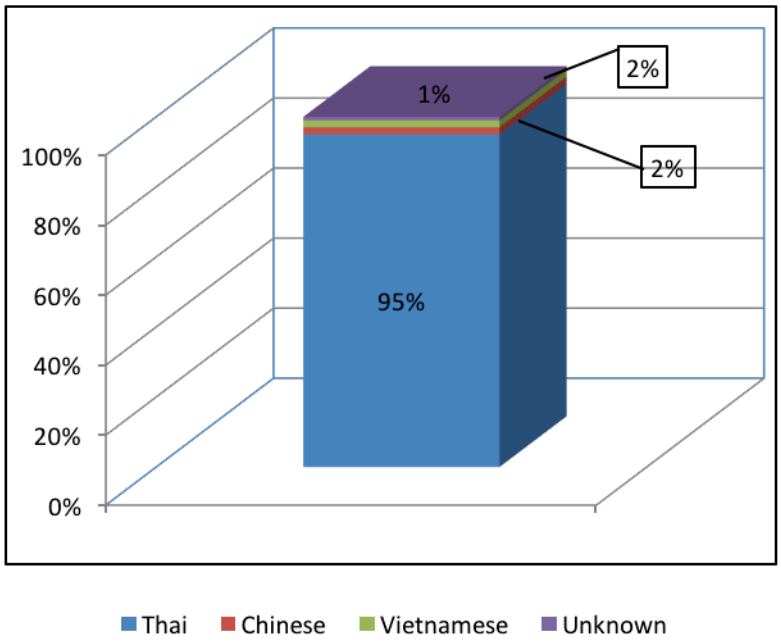


Figure 2. 33: Ko Si Chang III Ceramic Makeup (by percentage)

Lena Shoal (1490 CE)

The excavation team managed to log nearly 3,500 pieces of ceramics from the Lena Shoal shipwreck.[160] The published material on the wreck put more stress on the ceramics that had a more aesthetic appeal, rather than focusing on the whole ceramic complement. Therefore it was difficult to ascertain the exact amount of the ceramics found on board. Using the best estimates,[161] the proportional ceramic breakdown of the wreck is shown in figure 2.34:

[158] Green et al. 1987.
[159] At the time of excavation, the metals had become concretions and the negative impressions of these vessels showed their relative position within the bulkhead. For more on the metal of the Ko Si Chang III metals, see Chapter 3 in this body of work. Green et al. 1987, p.44
[160] Goddio et al. 2002, p.27.
[161] Orillaneda 2013

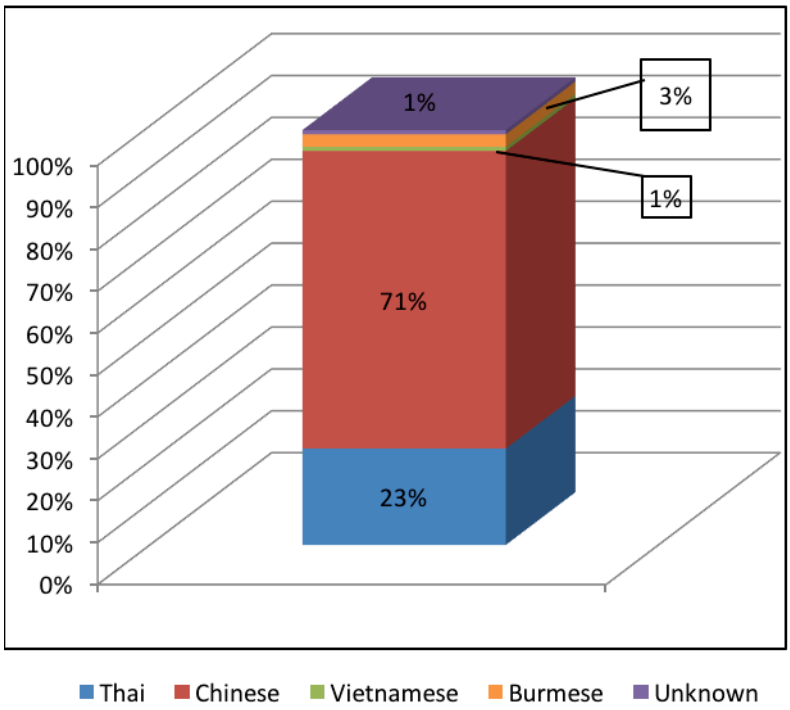


Figure 2. 34: Lena Shoal Ceramic Makeup (by percentage)

The majority of the cargo was composed of thousands of pieces of Chinese blue-and-white porcelain (Figs. 2.35, 2.36). While most of the blue-and-white was catalogued in the form of bowls and plates, more exotic types such as ewers, kendis, jars, and jarlets are also present. The Chinese wares on the Lena also include a small complement of green celadon material (Fig. 2.37), monochrome ware (Fig. 2.38), and "large quantities" of brown and black-glazed wares (Fig. 2.39).[162] Isolated pieces of Chinese *fahua* ware were also excavated from the site (Fig. 2.40).

[162] Goddio et al. 2002, p.222



Figure 2. 35: Chinese blue-and-white in situ. (Goddio, et.al., 2002, pg.18)



Figure 2. 36: Chinese blue-and-white plate. (Goddio et al., 2002, pg. 126)



Figure 2. 37: Chinese celadon from the Lena Shoal. (Goddio, et al., 2002 pg. 37)



Figure 2. 38: Chinese monochrome white ware. (Goddio, et al., 2002, pg. 187)

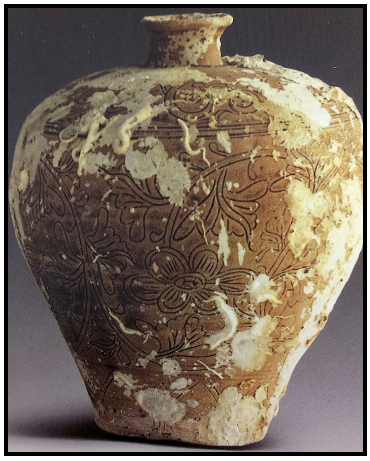


Figure 2. 39: Chinese brown-glazed ware.
(Goddio, et al., 2002, pg. 224)



Figure 2. 40: Chinese Fahua ware.
(Goddio, et al., 2002, pg. 189)

There were a few pieces of Vietnamese underglaze blue in the assemblage (Fig. 2.41), along with an undisclosed amount of Thai earthenware (Fig. 2.42), celadon (Fig. 2.43) and brown/black-glazed material (Fig. 2.44).



Figure 2. 41: Vietnamese blue-and-white ware.
(Goddio, et al., 2002, pg. 192)

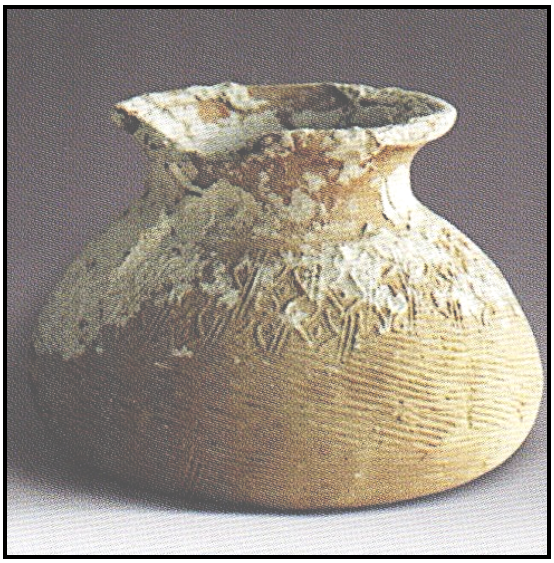


Figure 2. 42: Thai earthenware.
(Goddio, et al., 2002, pg. 230)



Figure 2. 43: Thai celadon ware. (Goddio, et al., 2002, pg. 36)



Figure 2. 44: Thai brown-glazed jar from Maenam Noi.
(Goddio, et al., 2002, pg. 34)

Newly discovered Burmese celadon was also identified as part of the Lena Shoal assemblage. Initially, Crick (in Goddio, 2002) does not attribute any of the celadon to Burmese kiln sites. Later research, however, has revealed previously unknown kiln complexes located in Burma, detailing a large centre of ceramic production in the region.[163] Some of the celadons in the Lena Shoal assemblage, once attributed as Thai Sawankhalok and Kalong manufacture, are now posited as being from these Burmese production centres; ceramic complexes that technologically rivalled those of China.[164] Thai celadon glazes are recorded as being an "ash-glazed stoneware", and the Burmese glazing tradition was more similar to the Chinese; high-

[163] Orillaneda 2008c; Brown 2009, pp.62, 185
[164] Rooney 2001; Brown 2009, p.62

fired, lead based glazed celadons.[165] Due to Monique Crick's recent ceramic analysis of both the Lena Shoal and the Santa Cruz wrecks,[166] and further corroboration of the Burmese material by Brown (2009) [167] and Orillaneda (2008),[168] I find that there is no reason to dispute this line of research.

This is another wreck that offered a glimpse into cargo loading procedures in medieval maritime Southeast Asia, not only due to the in situ condition of the cargo that it was found in, but also due to the quality of the excavation. Most of the ceramics were located in a tumulus on the seafloor, some of the cargo not having jostled from their bulkheads when the ship wrecked.[169]

Santa Cruz (1490 CE)

Of the 15,000 artefacts recovered from the 2001 excavation, 11,500 of these were ceramics of excellent quality. Eight thousand of these were brought up intact. The ceramic assemblage recovered from the wreck of the Santa Cruz is predominantly composed of high quality blue-and-white porcelain (Fig. 2.45) from China. In many ways this assemblage is very similar to that of the Lena Shoal wreck previously discussed. [170] Other Chinese ceramics found on site included Chinese monochrome ware (Fig. 2.46), celadon (Fig. 2.47) and brown-glazed wares (Fig. 2.48).

Vietnamese blue-and-white was also present (Fig. 2.49), along with Thai celadons (Fig. 2.50) and brown-glazed material (Fig. 2.51). Burmese celadons were part of the Santa Cruz assemblage as well (Fig 2.52). [171]

[165] At present, nothing has been published to this effect to confirm whether this is the case. If properly analysed, and the previously labelled Thai celadon plates turn out to be Burmese, it may alter trading patterns of these objects throughout the region.
[166] 2001
[167] 2009, p.185
[168] 2008b
[169] Goddio et al. 2002, pp.16, 20–21
[170] Goddio 2012
[171] Brown 2009, p.146



Figure 2. 45: Chinese blue-and-white plate. (FEFNA)



Figure 2. 46: Chinese monochrome ware. (FEFNA)



Figure 2. 47: Chinese celadon ware. (FEFNA)



Figure 2. 48: Chinese brown-glazed jar. (FEFNA)



Figure 2. 49: Vietnamese blue-and-white jarlet. (FEFNA)



Figure 2. 50: Thai celadon ware. (FEFNA)



Figure 2. 51: Thai brown-glazed bottle. (FEFNA)



Figure 2. 52: Burmese celadon. (FEFNA)

The proportional breakdown of the ceramic portion of the cargo from the Santa Cruz is illustrated in Figure 2.53:

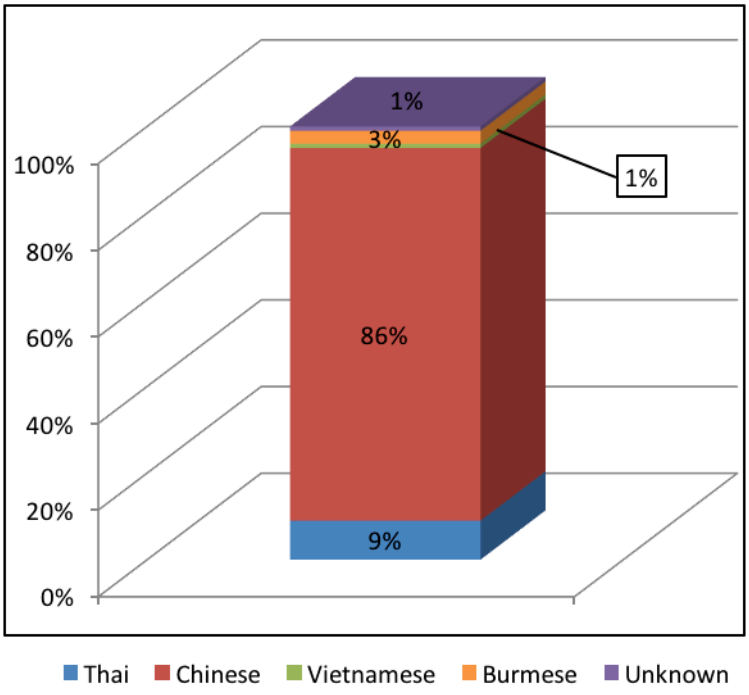


Figure 2. 53: Santa Cruz Ceramic Makeup (by percentage)

2.4 Discussion

The major objective of this chapter was to document the various types of ceramic materials from each shipwreck assemblage, and determine what information can be safely gleaned from it. Due to the large body of literature on the stylistic (e.g. iconography and pattern) and typological (e.g. bowl, plate, jar) aspects of Far Eastern ceramics, it was decided that it would not benefit to delve into studying this material in similar fashion in this thesis. Instead, one of the goals of this chapter was more to understand how the cargo as a whole is moving rather than a typological and stylistic study of Asian ceramics over a specific time.[172] An in-depth study of the popularity of one type of ceramic over another would contribute heavily to the scholarship of ceramic studies, a topic is deserving of its own thesis, rather than the cursory examination that would be offered in this chapter.

2.4.1 Ship assemblage narratives

By solely assessing the ceramic material found on these shipwrecks, the network pattern that is generated looks rather simplistic. Thus, the base narratives of the shipwrecks seem rather

[172] For stylistic and typological studies, see Carswell 2000; Rawson 1984; Brown 1977; Brown 2009; Rooney et al. 2010; Guy 1986; Guy 1989

bland. It is important to note that the images in these sections only pertain to the material found within the assemblage and makes no supposition into where the cargoes are loaded. There always remains the possibility that the items manufactured might not have been loaded onto these boats from their place of origin.

The Turiang is a Chinese-style ship that contained ceramics from China, Thailand and Vietnam (Fig. 2.56). Thai wares made up the bulk of the ceramic assemblage; nearly one-and-one-half times (57%) that of the Chinese ceramic material (35%). Vietnamese wares made up the difference (8%).

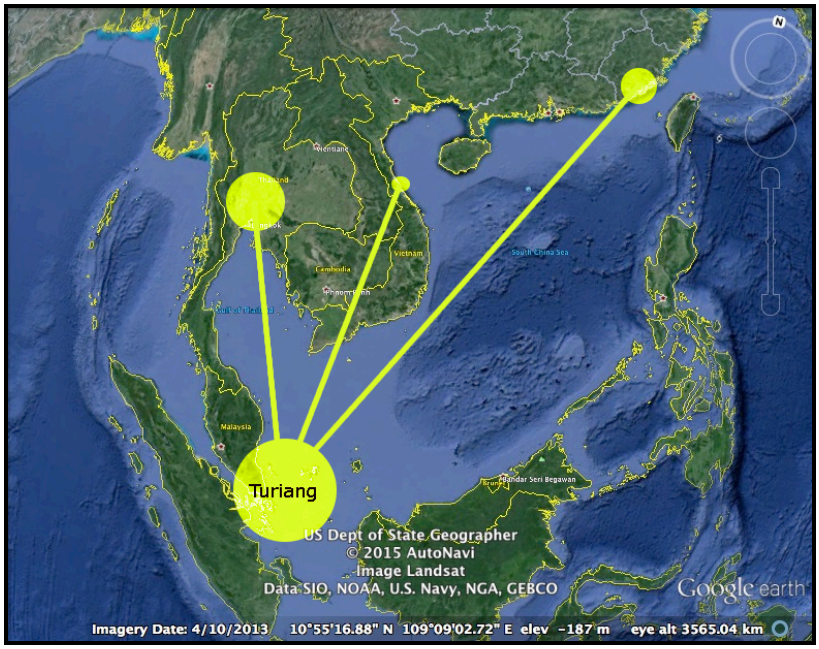


Figure 2. 54: Network of ceramics from the Turiang. (Google Earth, additions B. Fahy)

The Bakau is a Chinese-style ship that contained ceramics from China, Thailand and Vietnam (Fig. 5.57) Thai wares make up the bulk of the ceramic assemblage (67%), over double that of the Chinese ceramic material (32%). Vietnamese wares make up the lowest proportion (1%).

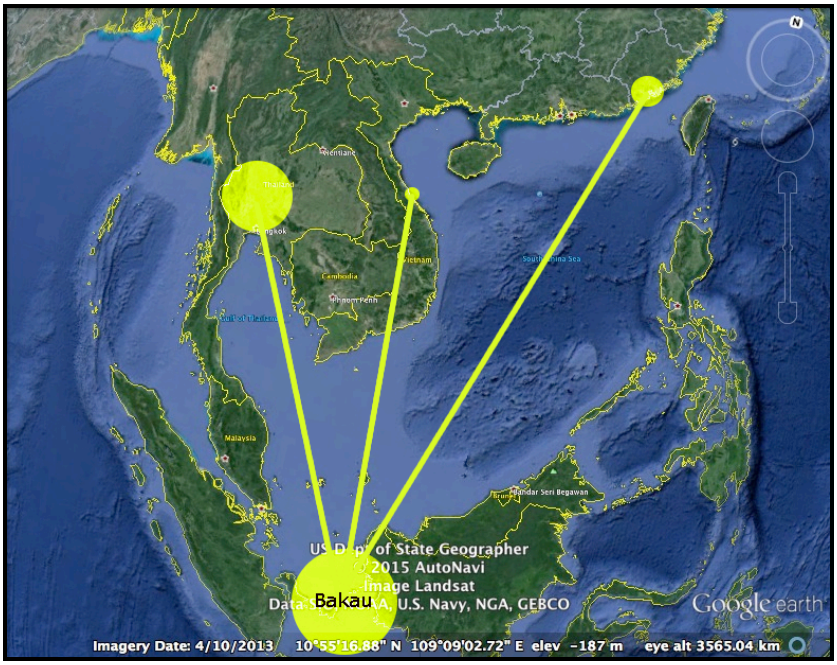


Figure 2. 55: Network of ceramics from the Bakau. (Google Earth, additions, B. Fahy)

The Rang Kwien is either a Japanese or Chinese style junk that contained ceramics from China, Thailand and Vietnam (Fig. 2.58). Thai wares make up the bulk of the ceramic assemblage (75%) with over four times as much material than Vietnamese wares (18%). Chinese ceramics make up the lowest identified portion (3%).

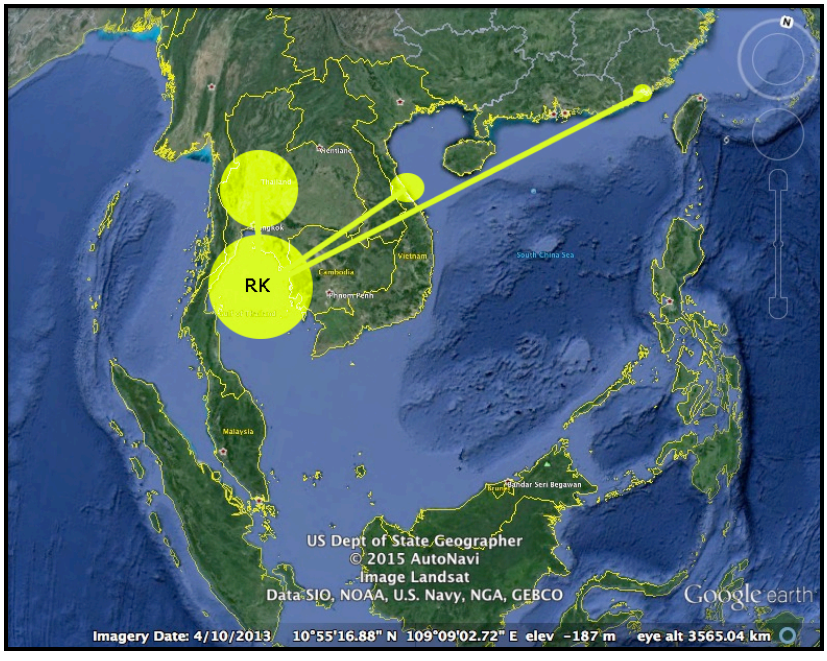


Figure 2. 56: Network of ceramics from the Rang Kwien. (Google Earth, additions, B. Fahy)

The Ko Si Chang III is a Southeast Asian-style vessel that contained ceramics from China, Thailand and Vietnam (Fig. 2.59). Thai wares make up most of the ceramic assemblage (95%). Very few Chinese (1%) and Vietnamese (1%) ceramics are part of the assemblage.

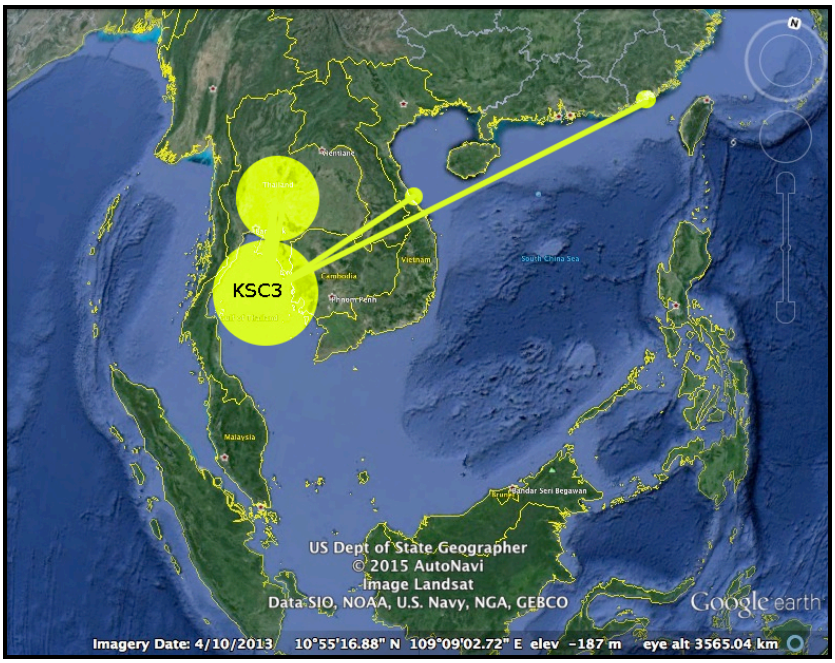


Figure 2. 57: Network of ceramics from the Ko Si Chang III. (Google Earth, additions, B. Fahy)

The Lena Shoal is a Southeast Asian-style ship that contained ceramics from China, Thailand, Vietnam, and Burma (Fig. 5.60). Chinese wares make up the bulk of the ceramic assemblage (71%), proportionally is over three times larger than its next largest ceramic type (Thai, 23%). Burmese wares (3%) and Vietnamese wares (1%) round out the cargo.

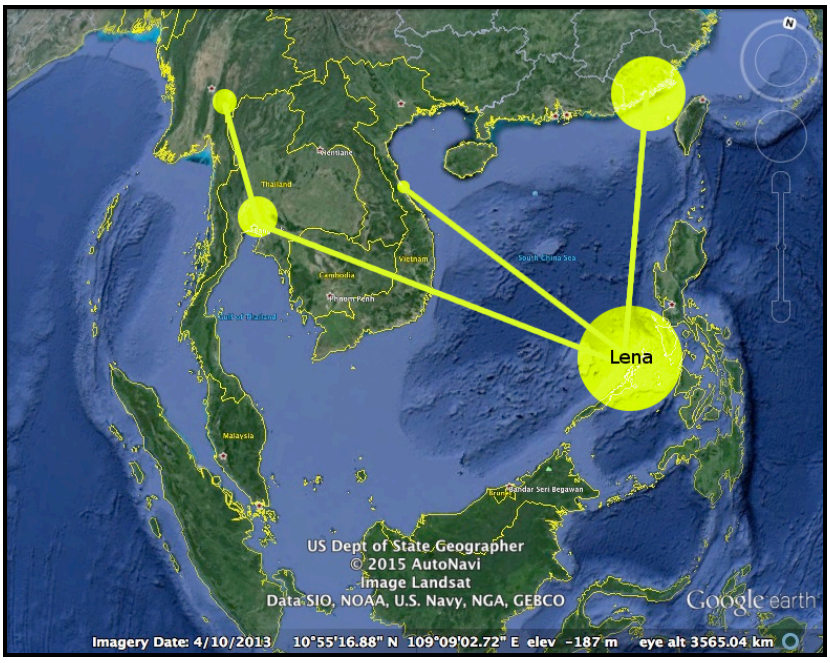


Figure 2. 58: Network of ceramics from the Lena Shoal. (Google Earth, additions, B. Fahy)

The Santa Cruz is a Southeast Asian-style vessel that contained ceramics from China, Thailand, Vietnam and Burma (Fig. 2.61). Chinese wares make up the bulk of the ceramic assemblage (86%), with Thai (9%), Burmese (3%), and Vietnamese (1%) making up the rest of the assemblage.

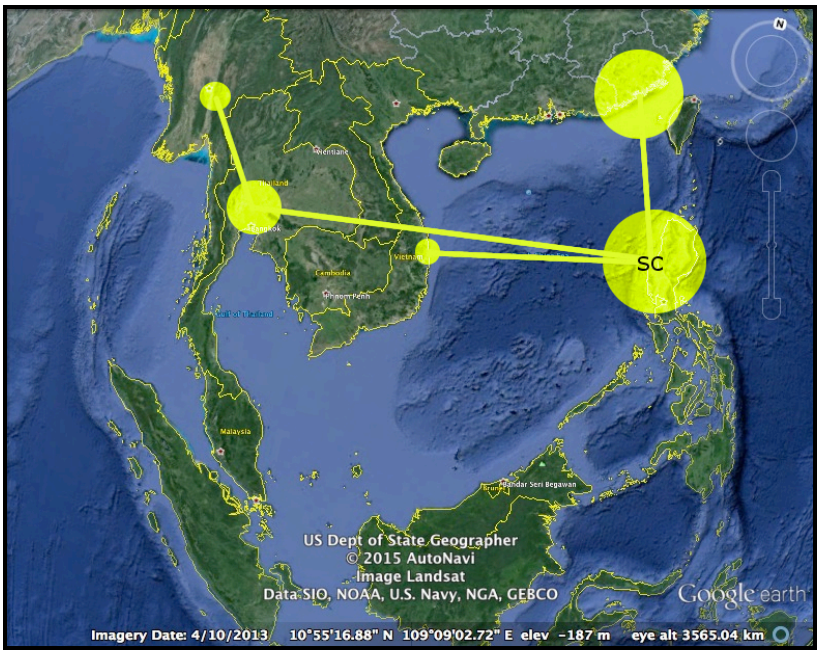


Figure 2. 59: Network of ceramics from the Santa Cruz. (Google Earth, additions, B. Fahy)

The low counts of Chinese wares on the Rang Kwien could represent a ceramic type that has been previously traded or material that has been selectively looted. It is possible that if the ship is actually from Ryukyu, there was always a low volume of Chinese ceramics in its hold.

Proportionally, Vietnamese wares are poorly represented in all of the case study vessels. The Bakau, the Ko Si Chang III, the Lena Shoal, and the Santa Cruz have less than 3% of this type of ceramic. It could signify a slowdown in trade with Vietnam during the Middle Ming period.

The ceramic counts of the Ko Si Chang III are too small to assume that the ship visited all three ceramic centres. Too few Chinese materials were found on it to support the theory that the ship visited Chinese ports. Green (1983) surmises that this ship is a local vessel bound for small ports between Vietnam and Thailand. Therefore, the appearance of the Chinese

material on that boat could be incidental.[173] While the Ko Si Chang III is the shortest boat in the study (~20m), there really is no great difference in width. It seems that the size of the boat does not determine ships that are coastal traders and those that are long distance traders. All the other ships in the study are between 24 to 30 meters long and 6.5 and 9 metres wide (where identified). The assumption that the Ko Si Chang III is a local trader could be from the assemblage alone.

Burmese wares appear to get introduced in the Middle Ming period. This could represent a burgeoning celadon tradition in Burma, but it is more likely that we have analysed the earlier shipwreck ceramics without knowing about Burmese kiln centres. The Burmese kiln site research is relatively new. Ceramic assemblages excavated previously to us knowing this information would benefit from a re-analysis.

The majority of these ceramic cargoes could reflect an increasing popularity of regional ceramic types, yet they may also simply reflect where the ship was within its trade route. The first three ships (The Turiang, Bakau, Rang Kwien) were Chinese built ships found in the Gulf of Thailand or in Indonesian waters. These three ships are all dated to the Early Ming period. It is assumed that these all came from China, the majority of their cargoes laden with Chinese ceramics. They may reflect a slow "offloading" of Chinese material as the ships travel throughout the South China Sea. A lower percentage of Chinese wares may mean that they had travelled to more ports and offloaded more of their Chinese cargo. The Lena Shoal and the Santa Cruz are both Southeast Asian styled vessels and were found in the Philippines. These are dated to the Middle Ming period and purported to have home ports in Southeast Asia. They may have been travelling a different route, originally laden with Southeast Asian cargo, and wrecked after offloading a majority of that material, which reflects a lower percentage of Southeast Asian wares. The Ko Si Chang III may have been a small boat only serving ports from Ayutthaya to Vietnam, but it may also represent a boat that had a large amount of Thai ware on its way to ports farther east.

A larger and far more difficult question to answer is how this ceramic comparison would change if these shipwrecks had not been looted, and how much can we rely on data from looted sites? All of the wrecks were looted to some degree, save the Ko Si Chang III, yet

[173] As mentioned previously, the sources connected to their respective boats believe that these ships were conducting a model of a "tramping" type trade, rather than a "catchment" type model. Studies in catchment theory in Southeast Asia may eventually change this.

were all discovered via fisherman who accidentally brought up ceramics, or by the observation of an influx of high quality ceramics in local black market shops.

When we look at the ceramic assemblages comparatively, the data shows a few interesting trends (Figure 2.54).

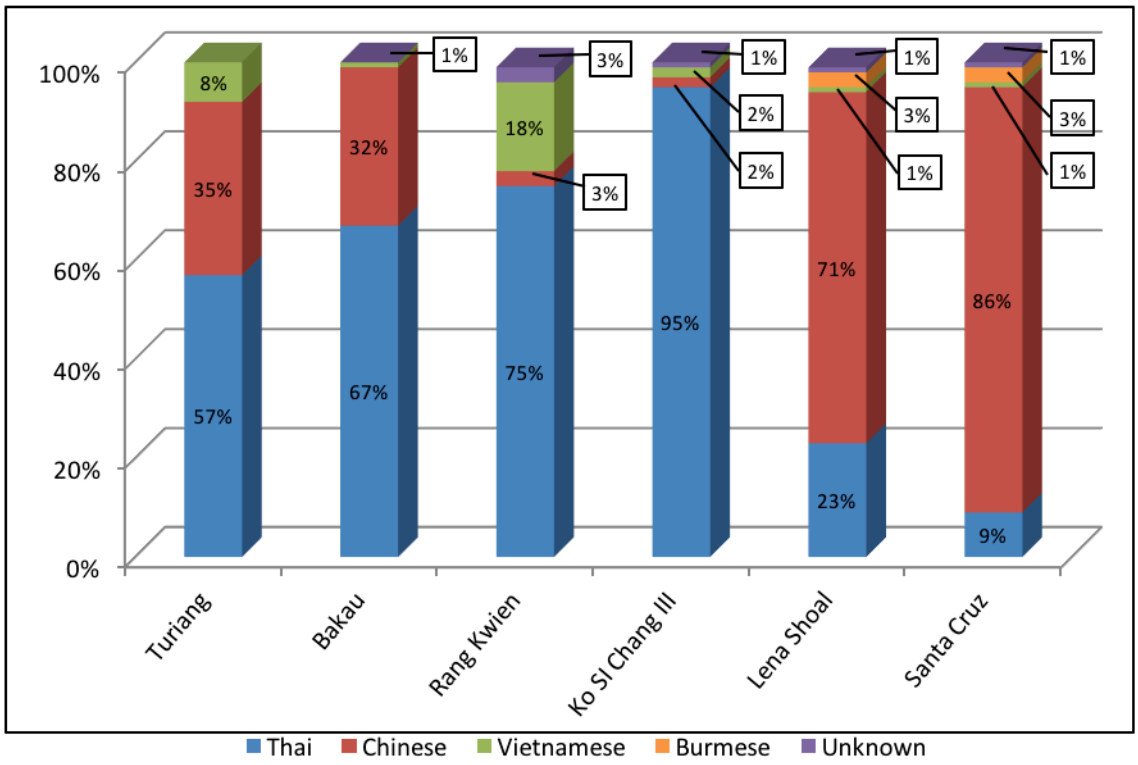


Figure 2. 60: Comparative Ceramic Makeup (by percentage)

Over 99 per cent of the recovered ceramic material from these wrecks come from the three major ceramic centres of Southeast and East Asia; China (64.7%), Thailand (30.3%), and Vietnam (2.7%) (See Table 2.1).[174] Since these three centres of manufacture makeup such a large portion of the various assemblages, every source pertaining to the wrecks assume that every ship (saving the Ko Si Chang III) has visited those respective trading centres, likely trading cargo previously on board.[175]

[174] These figures represent a best estimate since complete inventories were not available on some of the wrecks. In the cases where we can confirm a "presence" of a type of ceramic, a minimum count was used (e.g. If we knew there was celadon from Thailand on a ship, but no exact counts, then the amount of Thai celadon was "one". If there was a range of ceramics recorded (e.g. 400-800 jars), then a medium number (600 was used). I believe if we had exact counts, the proportional percentage of ceramic material from these would only be higher.

[175] Brown & Sjostrand 2000; Intakosai 1983; Flecker 2001b; Green et al. 1987; Goddio et al. 2002; Orillaneda 2008c

Table 2. 1: Regional Proportions of Ceramics

Ceramic origin	Total Ceramic Count	Proportional percentage (of total)
China	14, 197	64.7%
Thailand	6,660	30.3%
Vietnam	598	2.7%
Burma	360	1.6%
Unknown	124	.6%
Philippines	5	.02%
Total Ceramics	21,944	99.92%

This emphasizes a current debate in the theories pertaining to maritime trade within Southeast Asia. It is the question of whether trading was conducted through a tramping-styled or emporia-based trade patterns.[176] The tramping trade model acts as such: a ship stops at a port, drops cargo off, picks local cargo up, then travels to another port "down the line", where the cargo exchange starts again. With the emporia-based model, a ship from port A travels to port B, drops all its cargo off, picks cargo up from a multitude of other areas that are plying trade at port B. The ship then returns to Port A, laden with foreign goods (Fig. 2.61).

[176] Arnaud 2011; Rice 2011; Steel 2013, pp.138–9

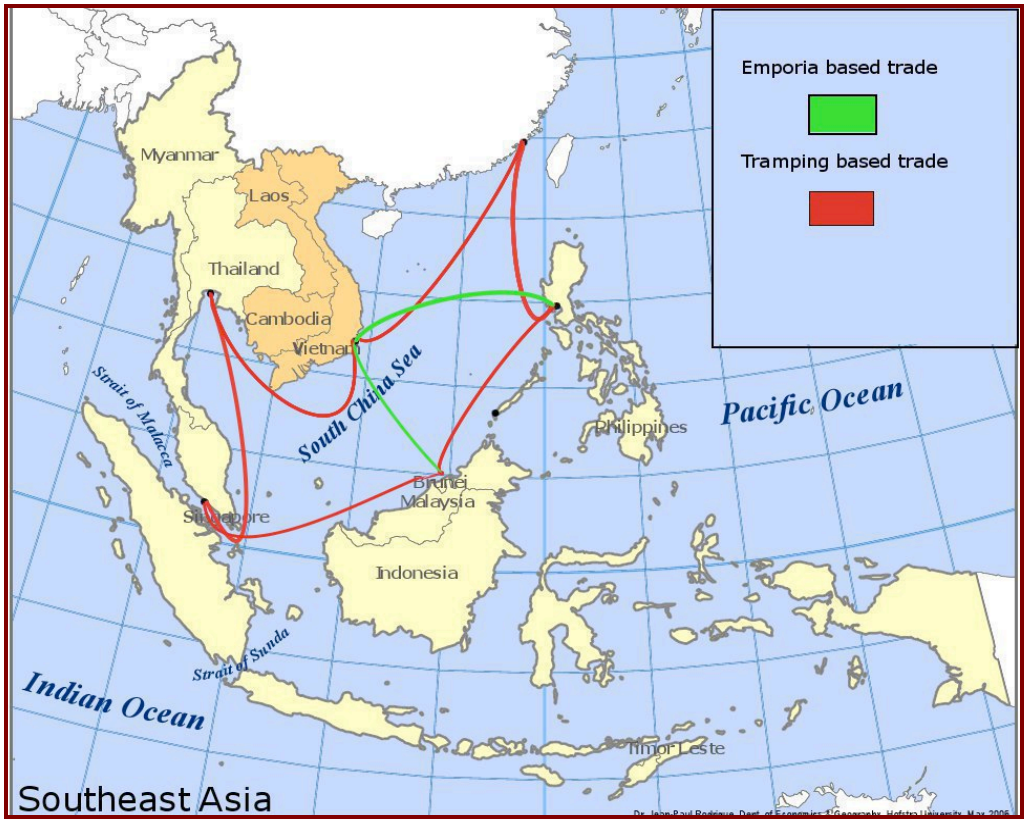


Figure 2. 61: Tramping and Emporia based trade models.

It is said that the tramping-styled trade was conducted in accordance with the monsoon season throughout the South China Sea. [177] For six months out of the year, the winds blow northeast to southwest, then in the other half of the year the winds reverse, blowing from southwest to northeast. Ships would then use the winds to travel in one direction, anchoring at ports linearly for one half of the year, then travel back in a homeward direction for the other half of the year, either revisiting the ports on the outward leg, or visiting a set of new ports on its way back to complete the trading circuit.

It is my belief that the ceramic complements in these shipwrecks lend credence to support a tramping styled trade, at least in the Early Ming period. If the ships that have been identified as being "Chinese built" and were employing an emporium based trade model, they would not have Chinese ceramics in their hold. They would have dropped their export cargo and had all foreign cargo in their holds. Additionally, archaeologists have found no shipwreck assemblage that has a geographically homogenous cargo assemblage. There is material from several cultures on every shipwreck (of varied amounts). Until we find a ship that exclusively has all Chinese material (or other Southeast Asian culture) in its assemblage, we

[177] Reid 1993, p.65; Tripati & Raut 2006; Lehman Jr. 2015, p.7

cannot assume emporia are being used exactly in this fashion. Detailed concepts of emporia and non-emporia trade will be discussed further in Chapter 6.

2.4.2 Can we trust the statistics? The preferred looting of porcelain

Ultimately, we cannot rely on original ceramic counts in shipwrecks as most shipwrecks have undergone a high amount of looting. This is particularly true with high quality ceramics due to an intrinsic demand on the antiquities market for these types of products. Historian Sir John Plumb sums up the insatiability for these objects by saying, "[n]o mania for material objects had ever been so widespread, so general to the rich of all nations".[178] The international desire and consumption that the public has for porcelains is every bit as strong today as it was centuries ago. Modern blue-and-white porcelain is still popular with the masses, and accessible to all social classes. The division between the modern reproductions and looted original material; the common versus the rare; becomes the new status symbol. Looted porcelain becomes an object that has a pedigree. Porcelain wares are the types of material that looters are looking for rather than their earthenware counterparts. The earthenware ceramics are also still manufactured and in use today, but the aesthetic "status" of earthenwares was never comparable to the higher quality wares. This practice of attributing a hierarchy on ceramics is widespread. Consumers and (therefore) looters place a higher regard for these high quality wares rather than earthenwares, and similarly, the shipwreck excavations reveal this practice as well.

It is true that high quality ceramics survive better in shipwrecks in Southeast Asia. They are densely packed which sometimes protects them against breakage. The sheer quantity and method of stowage offers more opportunity for survivability. Many of the earthenwares are containers rather than tableware (plates, bowls). Containers do not stow as compactly as flatware therefore does not provide the extra protection that tightly-packed tableware offers. Also, if the ratio of porcelains to earthenwares is high (for example, 10:1), the ratio of surviving pieces to broken pieces is just as great. This assumes that all of these wares are located within the cargo hold. The denseness of the packed cargo (in the case of large amounts of porcelain) aids to this protection as there is less surface area exposed to the environment. Therefore, wares that were loaded in the bulkheads of these ships tended to

[178] 2013, p.57

remain intact. Utilitarian wares that were likely stored above deck skews the ratio of surviving pieces to broken pieces even further.[179] Ceramics that were kept on deck would be more likely to fall off and break as the ship wrecked. Ideally, a statistical analysis could be done on the "bulkhead versus deck" survivability ratio, but more unpublished data must be obtained from excavators. Additionally, the glazing on high quality ceramics can act as an extra layer of protection between salt corrosion, concretion and natural agents that earthenwares (and low quality stonewares) sometimes do not have.

Due to the survivability of these wares, coupled with the aesthetic beauty universally ascribed to higher quality ceramics, more attention is then given to them in both physical popularity as well as in the literary publications. Therefore, the ways in which these wrecks have been published make them virtually unrelatable to one another. We cannot compare the sources because they are not all intended for the same consumer market. The catalogue of the Lena Shoal for example, caters to an art-appreciative market, by focusing on the wares that are the most artistic. The catalogue does not give us exact counts of the ceramic material and only four of the 130 pages devoted to ceramics cover earthenwares.[180] Due to the small amount of published material on the Rang Kwien[181], the Bakau[182] and the Turiang[183], the earthenware ceramics are barely mentioned. Of all the wrecks in this case study, Green's report on the Ko Si Chang III gave the most detailed representation of the earthenwares in the assemblage, because its audience was more academic in nature. [184] This report is also the only one to record and publish both the sherd count and weight of the average type of ceramic, to better gauge an exact representation of the wares on board.

2.4.3 The greater visibility of porcelain in the scholarly record

Studies into the distribution patterns and economics of the ceramic trade in the region are finally being conducted. Since there is an increasingly availability of excavated terrestrial sites in Southeast Asia, archaeologists and economists are attempting to analyse the dispersement of these objects. Only one paper that exclusively discusses the earthenwares

[179] Sjostrand & Barnes 2001
[180] Goddio et al. 2002, pp.99–233
[181] Intakosai 1983; Intakosai 1984; Vatcharangkul 2013
[182] Flecker 2001b
[183] Brown & Sjostrand 2000
[184] Green et al. 1987

recovered from a shipwreck site has been published.[185] Since there is less published work on earthenware ceramics to draw from, these wares are still being marginalized. This misrepresentation of earthenwares is "described away" in many of the sources by a re-categorization of the ceramic material into "Trade ware" and (assumedly) "non-tradeware", or the research is stressed as being focused on "Chinese ceramics" or "Porcelains".[186] Since porcelain and high quality ceramics have a larger trading footprint, and are found in shipwreck assemblages in the cargo holds, the term "Trade ware" is used to focus on this type of material. Earthenwares, then, are barely discussed in these analyses, if at all, yet they are most assuredly a trade ceramic.

2.4.4 The joy of coarsewares: extending the analysis beyond porcelain

It is generally accepted that material was stored in earthenwares either for ship use or the commodity trade. They commonly held rice, or water on either the deck, or in a portion of the cargo hold.[187] The omission of these materials as "trade ceramics" is likely due to the lack of research on them, and the bias towards Chinese porcelain. It must be stressed though, that earthenwares were indeed a widely traded ceramics throughout Southeast Asia. Most sources point to Thailand as being the point of origin, and we still see this style of ceramic used today.[188]

All of the identified earthenwares on these wrecks are all containers or lids (of containers). They are not tableware (plates, cups, nor bowls). They are meant to "contain" something. All of the jars may not have had something in them, but those that did, had material intended for trade or consumption. When we talk about "trade ware", we are not simply talking about the items themselves and the material contained within, but the concepts of interaction and the meanings incorporated within these networks.[189] These vessels reveal important information about the rice trade, or about ship dynamics pertaining to food storage and preparation on board. These vessels are colloquially known as 'rice-pots' and have been observed as vessels

[185] Tanaka & Dizon 2011
[186] Miksic 2007; Batchelor 2006; Witkowski 2013; Brown 2009
[187] Sjostrand & Barnes 2001
[188] Goddio et al. 2002; Liow 2013
[189] See Knappett et al. 2012

specifically used to cooking rice. The pots can be put into or over a fire, until the water in the pot boils and cooks the rice inside.[190]

These earthenware vessels not only can be defined by their use, but could also be an actual unit of measure, offering an interesting perspective on economics. An exciting application of this would be to obtain an earthenware jar from the era and fill it with rice. One then pours out the rice to weigh the contents and see if it the weight correlates with any known mass amount in fourteenth and fifteenth century Southeast Asian or Chinese written record. Zhao Rugua recorded the costs of rice in certain markets; In Cambodia, "For every tael of lead one can buy two bushels of rice";[191] In the Malay Peninsula, "…two töng of rice is equal to one tael of silver;[192] and in Central Java, where one piece of minted silver is worth 100 shöng (one peck) of rice.[193] Wicks has documented some of the local Southeast Asian, Chinese and South Asian units of measurement and translated them to modern metric measurements.[194] A "*Tael*" (also known as a "*liang"* in China) is 1/16th of a "*Jin*" (500g). A fifteenth century "tael" translates to 37.30 grams.[195] The "tong" is translated from the Indian "tula", which equals 38.4 grams.[196] A "shöng" of rice is likely Wicks' translation of "Sheng", which equates to a Chinese pint, or 1.07 litres in the fifteenth century.[197]

The use of "bushel" and "peck" in Hirth and Rockhill's translation of Zhao Rugua's makes this somewhat more confusing, because these terms measure volume and not weight. To properly understand the weight ratios, a "bushel" and "peck" must be measured out (1 (Imperial) bushel = 2229.36 cubic inches (in^3)), then weighed to better relate to the terms that Zhao Rugua is using. We then have a baseline with which to compare the carrying capacities of the earthenware jars, to better understand the grain trade and/or ship provisioning in the region.

The lack of an aesthetic preference for earthenwares acts as a blessing. Lower quality vessels can reflect a more truthful account of this type of trade, purely due to the fact that those wares

[190] Skibo et al. 1989; Stark et al. 2000
[191] Hirth & Rockhill 1911, p.53
[192] Hirth & Rockhill 1911, pp.68–9
[193] Hirth & Rockhill 1911, p.82
[194] 1992
[195] Wicks 1992, p.351
[196] Hirth & Rockhill 1911, p.69; Wicks 1992, pp.352–354 Wicks notes that the "Tula" is also known as a "Suvarna". The "suvarna" is equal to 16 "masa", which is 2.4 grams. 16 x 2.4 grams is 38.4 grams.
[197] Wicks 1992, p.353

are in less of a demand in the looted antiquities trade. Their presence in a shipwreck assemblage remains in the looted site therefore it represents a more accurate account of the actual amount of earthenware vessels. If these wares survived better, or were deemed more exotic by collectors, this would not be the case. In this example, all parties; looters, consumers and archaeologists are treating this material as a type of artefact worth "less than" that of porcelain material. Earthenwares can tell you more about the movement of these ships, and of that type of ceramic, because we are less likely to see these wares looted. When we marginalize this group of ceramics, either for aesthetic reasons or by simply not acknowledging that a lack of research has been done on them, we do them (the marginalized group) and our audience a disservice. This focus on high quality ceramics and porcelains is likened to the antiquarian days of archaeology, when the focus is solely on the high-quality material, and the lives of the high status individuals that use them.

3.0 Metallurgical Assemblages

3.1 Introduction

The goal of this chapter is to highlight the various metallurgical objects found within each shipwreck in order to better understand the depth of material and add further detail to the narrative of each of the ships derived from pottery alone. First, a comprehensive list of metallurgical material is identified and catalogued from each shipwreck. Next, a detailed biography of the various types of items is set out, with the aid of available archaeological and written material. The items are then divided into groups of either manufactured or raw materials. Manufactured materials can be further classified as either commodity wares or items for shipboard use/personal material. Objects whose role on each vessel cannot be deduced will remain unassigned.

Quantification methods were used as the criteria to delineate personal material/ship use material versus material on board for trading purposes. Isolated items and groups of items tallying less than three were assumed to be individually owned or ship property, while items that comprised of four or more were identified as trade material. Nautical themed artefacts (e.g., net weights and sounding weights, fishhooks, and cannons) are catalogued as ship use material regardless of inventory amounts. Mundane isolates in the assemblages (i.e. spoons, dishes, cauldrons) will be classified as personal or ship-use. Cannons are identified as shipboard items as part of its armament. Individual high-end artefacts (e.g., jewellery, crown) are treated as either personal use or tribute wares. These criteria are also dependent upon the information gained regarding each ship excavation. If any of the isolated finds can accurately be provenanced in the respective cargo hold, then it shall be noted and deemed a trade good or tribute item. The qualification of the material highlighted in this chapter is in Appendix 2.[198] Each ship's assemblage is laid out temporally along with their respective inventory to plot shipping trends and to discern whether the material was a tradable commodity or material that might be for personal or ship use. Manufactured material that was definitively found within a cargo hold or found stacked and grouped together will be classified as a tradable commodity. Any items where counts are too low or provenance is uncertain will be treated as undetermined.

[198] Due to item concretions or degradation, counts may be estimated. Qualifying details will accompany material counts that could not be confirmed.

In keeping with their marginalized role in the scholarly literature and in publications of the wrecks, metal items are seldom analysed or illustrated, and only have scant references made to them. Consequently, in order to gauge the quantity of these valuable objects, it was necessary to conduct post-excavation and post-publication fieldwork in the storerooms and archives of the National Museum of the Philippines, the Underwater Archaeology Museum in Thailand, and the Experiential Museum in Singapore. In this way, it was possible within the scope and time frame of this thesis to observe these materials, properly document them and corroborate them with the published information pertaining to these assemblages. In the spring of 2013, I was able to re-research 5 of the 6 shipwrecks in this case study.[199]

3.2 Metallic corrosion in an underwater environment

This discussion of these shipwrecks in my sample highlight the lack of existing scholarship on metallurgical material in shipwreck publications in Southeast Asia, raising the question of why such artefacts have not been the focus of greater research. The reason may be a matter of aesthetics, since corroded metalwork does not have the same intrinsic artistic beauty as ceramics; or one of quantitative substance, in that too little metallurgical material survives; one of technological restriction, where scientific methods are not yet sufficiently advanced to glean adequate data; or simply money driven since ceramics sell. Metals are difficult to conserve and there is a smaller profit margin and smaller market for it compared to ceramics. In the case of each item a combination of explanations may exist for the lack of metallurgical research, and a number of such cases are explored. Before we can scrutinise the material itself, however, we must first understand its physical and chemical relationship within the environment where it is found.

It should be stressed here that this section deals with the general principals of metallic corrosion. The specific reactions of each type of metal will be addressed within each section (i.e. iron corrosion in the iron section, tin corrosion in the tin section.)

Metal assemblages constitute a small percentage of the full complement of archaeological material taken from most wrecks. In all shipwrecks of this time period, only the Rang Kwien and the Ko Si Chang III contains more metallurgical materials than ceramic material. The environment from which these materials are recovered certainly contributes to this dearth of

[199] Despite repeated attempts to contact the National Museum of Malaysia, I was unable to get permission to study the assemblage of the Turiang.

metal finds. Even after being immersed in seawater for over half a millennium, ceramics tend to maintain their composition (they are more likely to be destroyed by human agents).

Whereas ceramic material seems to generally maintain its structural integrity under water, the metallurgical material, through constant exposure to seawater, undergoes chemical changes. The mixture of biological, mineralogical and chemical materials present in seawater acts as a very corrosive medium for immersed metals.[200] Every metallic item exposed to this environment is subject to *galvanic corrosion*, an electrochemical process that occurs when metals are immersed in an electrolytic medium, in this case, seawater. Table 3.1 shows the average concentration ratio of dissolved salts in various bodies of water. While this percentage is relatively stable in seawater, the total mass of dissolved salts can vary significantly between one body of water and another (and indeed, sometimes between various sections of any one respective body). Salts represent the major agent of corrosion on materials in seawater; therefore the rate of corrosion in bodies of water with higher salinity is faster than those with a lower salinity ratio.

Body of Water	Salinity (%)
Rivers	0.1
Baltic Sea	< 17
Black Sea	18-22
Atlantic and Pacific Ocean	32-35
South China Sea	34-35
Mediterranean Sea	39-47
Red Sea	43-45
Dead Sea	276

Table 3.1: Salinity ratios of various bodies of water. (Based on Memet, 2007)

The surface salinity of the South China Sea falls between those of the Pacific Ocean and the Mediterranean Sea at about 34-35 per cent (Fig. 3.1). A somewhat higher surface salinity is measured between the South China Sea/Philippine Sea interchange, where the Pacific Ocean spills into the South China Sea. The freshwater runoff from the Mekong Delta lowers the salinity concentration along the coast of mainland Southeast Asia.[201] While surface salinity changes throughout the region, the salinity ratio is quite consistent at depths lower than five

[200] Memet, J.B. 2007, pp.152–169
[201] Yu et al. 2008

meters. It remains steady throughout the South China Sea and the Gulf of Thailand, at approximately 36 per cent (Fig. 3.2).[202]

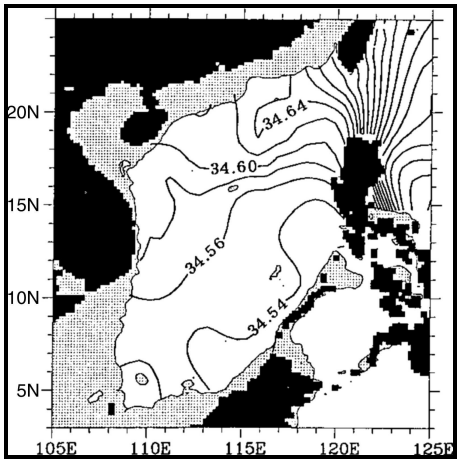


Figure 3. 1: Mean salinity distribution of South China Sea. (Zuojun Yu, et al., 2008)

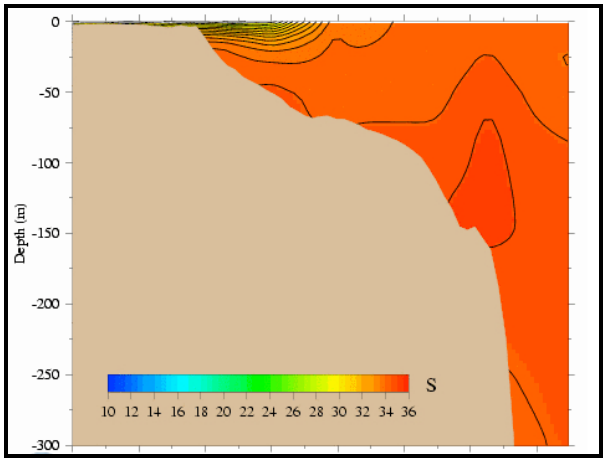


Figure 3. 2: Salinity Ratio in the South China Sea below 5 metres. (MEDM, 2005)

The Galvanic Table (Table 3.2) was initially created to assist nautical engineers with their selection of metals for maritime and underwater construction, particularly at a junction where one type of metal meets another type of metal. Ideally, the best practice in nautical engineering is to use one single metal throughout any construction. For example, in modern boat construction, aluminium works best as an architectural material, yet fasteners and accents are generally manufactured in stainless steel, due to its strength and ease of construction. It is at these intersections of multiple metals where galvanic reactions occur. The electrolyte compound that is seawater offers the means for ion migration between the two immersed metals. The Galvanic Table is being used in this study to predict the reliability of survival of metallurgical artefacts from shipwreck assemblages. Each metal has a distinct electrode potential, represented along the galvanic scale from most noble to least noble. The nobler the metal is, the less likely it is to corrode (Table 3.2).[203] Hence, a metal that is less likely to corrode has an increased chance of survival in seawater.

[202] Shi et al. 2002
[203] Roberge 2006, pp.341–343

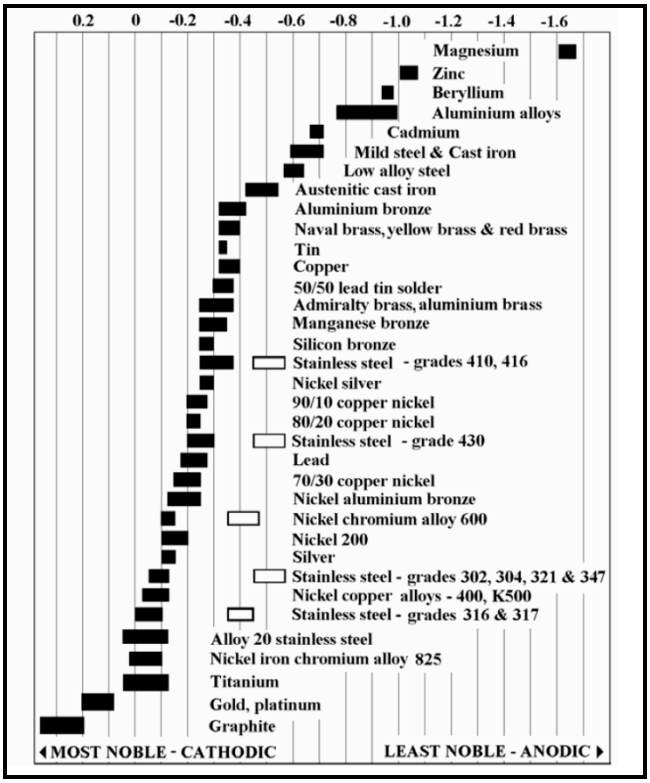


Table 3.2: Galvanic index (http://l-36.com/corrosion.php)

When two metals are conjoined in this type of environment (either by fastening or by smelting), one metal acts as the anode (electron acceptor) and the other acts as a cathode (electron donor). Metallic ions move from cathode (more noble) to anode (less noble), accelerating the rate of corrosion of the more anodic material. Due to the temporal scope of this study, we are unlikely to encounter any joined metals; rather, we will look at smelted materials like bronzes, which are also affected by galvanic reaction and thus will show signs of bimetallic corrosion. This will be discussed at greater length later in this chapter.

Although galvanic interactions are less likely to occur in this study, the premise serves as a baseline by which to discuss noble and non-noble metal reactions in seawater. Most of the metals discussed within this chapter are paired with like metal material (cargo that was loaded together), therefore there is a certain homogeneity when dealing with metallic corrosion in seawater, however, understanding the Galvanic Index aids us in predicting which metals are more likely to undergo corrosion in this environment and provides us with general comparative rates at which each metal corrodes. For example, it is to be expected that in such an electrolytic setting, cast iron is more likely to corrode than gold, due to its higher anodic nature. Archaeologists and conservators are more able to rescue and protect nobler metallurgical material, due to its lower rate of corrosion. Iron materials, as noted, suffer a

harsher fate in an oceanic environment and consequently, they are more likely to corrode into a state where they are unrecognisable, are difficult or too costly to conserve and as a result the information on the subject is minimal.

The factor most affecting corrosion rates in seawater is conductivity; the higher the conductivity in an environment, the greater the rate of material corrosion. Features such as salinity, pH levels, temperature and dioxide concentrations are also major factors involved in the rate of metallic corrosion. Dioxide gases (in the forms of O_2 and CO_2) are present in seawater to varying degrees, dependent upon the interaction of sea and atmosphere, oxidation, respiration of any breathing species, and photosynthesis. Obviously, the higher the temperature of the seawater, the more comfortable the environment for aquatic life forms. This then contributes to a greater concentration of dioxides and accelerated levels of corrosion. High concentrations of dioxides in seawater contribute to accelerated rates of corrosion between "active" metals such as copper and iron.[204]

Corrosion rates decelerate the deeper the location of an artefact. A wreck located above 10 metres is constantly affected by wave turbulence, and inhabits a higher dioxide environment than a wreck below 10 metres. A colder, darker and slightly more sterile environment is advantageous to a wreck site. A percentage of all underwater sites are underneath a layer of sediment, which inhibits the diffusion of dioxide through the matrix. Measured levels from underwater harbour structures between the soil surface and several centimetres below the soil (sand) show dioxide levels decreasing from 8 ppm (parts per million) to 2 ppm.[205]

To sum up, metal objects on these wrecks will corrode in the waters of the Southeast Asia. The rate to which this happens is dependent upon the depth of the wreck, the rate of sedimentation (the degree to which the ship is buried) and trawling (the rate at which the sediment is removed). Trawling damage then opens up the objects to renewed corrosion.

[204] Roberge 2006
[205] Memet, J.B. 2007

3.3 Metal inventories of the case study assemblages

The wreck assemblage list below is compiled chronologically, first highlighting wrecks of the Early Ming Dynasty (1370 CE - 1430 CE), and then focusing on the wrecks of the Middle Ming Period (1450 CE - 1510 CE).[206]

3.3.1 Early Ming Wrecks:

Turiang (1370 - 1400 CE):[207]

Large lumps of iron oxide[208] were found strewn throughout the wreckage of the Turiang ship. The shape and appearance of these iron lumps imply that this cargo was shipped in a granular form (Fig. 3.3). It is quite common for iron in this form to create a concreted mass when exposed to seawater. In these situations, (where iron in powder form was stowed around ceramics and exposed to seawater for a long duration) these concretions occasionally envelop the ceramics. Similar iron lumps were recovered from the Royal Nanhai wreck, alongside traces of flattened bamboo. The existence of flattened bamboo suggests that the iron granules were stored in bamboo bags.[209] These bags not only made decent ballast for the ship, but also probably worked rather well as a securing mechanism for more fragile items. In an aquatic environment the bamboo degraded, and the loose powder filled the gaps of the ceramic material below, leading to ceramic inclusions within the iron masses. No iron in ingot form was recovered from the site.[210]

[206] Brown 2009, pp.38–42
[207] For a full itemized list of metallurgical artefacts, see Appendix 2.
[208] Brown & Sjostrand 2000, p.14Brown and Sjostrand identify "several" lumps. No exact number is given.
[209] Brown & Sjostrand 2000, p.14,39
[210] Brown & Sjostrand 2000; Sjostrand & Barnes 2001



Figure 3. 3: Example of iron in granular form.
(www.rsigritech.in)

Rang Kwien (1400 – 1430 CE):[211]

Dubbed the "coin wreck", The Rang Kwien's major metallic cargo was nearly 200 kilograms of Chinese coins (4,834 coins). Some of the coins date from as early as the 4th Century yet the majority seem to come from the Hongwu reign (1368-1398 CE) (Figs. 3.4, 3.5). The boat also carried eight copper ingots in its hold. Blast holes are visible throughout the wreck, demonstrating a tactic used by treasure hunters to break up the copper and coin concretions for ease of transport. Precious metals off the Rang Kwien include two early Ayutthaya-style gold bangles and one gold ring with gems (Figs. 3.6, 3.7). Additionally, the excavation crew documented one bronze gong (Fig. 3.8), one bronze mirror, one bronze bell, and three bronze lime pots as part of the assemblage. Fishhooks, bronze harpoons, and hairpins were also present — material reflecting life on board the Rang Kwien.[212] The second training excavation conducted by the Underwater Archaeology Division of Thailand in March of 2013 yielded more metallic cargo; additional copper ingots (totalling eleven) and a miniature bronze tool (Fig. 3.9).

[211] For a full-itemized list of metallurgical artefacts, see Appendix 2.
[212] Intakosai 1983; Intakosai 1984



Figure 3. 4: Coins from Rang Kwien wreck.
(Underwater Archaeology Division, Thailand)



Figure 3. 5: Coins from Rang Kwien wreck.
(Underwater Archaeology Division, Thailand)



Figure 3. 6: Gold bangles from the Rang Kwien wreck.
(Underwater Archaeology Division, Thailand)



Figure 3. 7: Gold and gemstone laden ring.
(Underwater Archaeology Division, Thailand)



Figure 3. 8: Bronze gong from Rang Kwien wreck.
(Underwater Archaeology Division, Thailand)



Figure 3. 9: Miniature bronze tool from Rang Kwien wreck.
(Brian Fahy)

Bakau (1410-1430 CE):[213]

In the initial report of the Bakau assemblage, the terms that Flecker used to describe the metallurgical assemblage were somewhat vague.[214] The inventory for this wreck, provided by the Maritime Experiential Museum in Singapore, revealed dozens of items from this wreck that were never published. Ten bronze guns were recovered, along with over two hundred

[213] For a full-itemized list of metallurgical artefacts, see Appendix 2.
[214] Flecker 2001b Flecker uses terms such as, "small stacks", "an array", and "numbers too small to warrant".

Chinese coins from the Yong-Lo period of the Ming Dynasty (1403 - 1424CE).[215] Ten bronze mirrors along with eight mirror handles were found, all of which were detached from one another. Six pairs of copper alloy tweezers, one bronze bell, and seventeen bronze gongs were a part of this assemblage, as well as two pewter carafes and one metal kendi.

Tin ingots were recovered, along with a myriad of personal and professional copper alloy effects: crew use items such as scissors, rings and lamps; hunting objects like fish-hooks and spearheads; metal dining wares like bowls, plates and spoons; as well as scale, net and sounding weights (Fig. 3.10).[216]

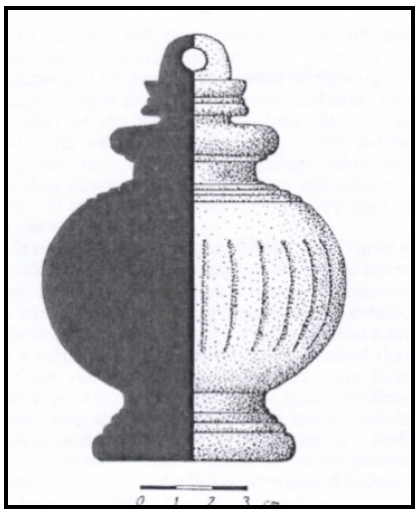


Figure 3. 10: Sounding weight from the Bakau wreck.
(Flecker, 2001)

The partial documentation and recovery of this assemblage reflects one of many problems when dealing with a wreck excavated by treasure hunters.

3.3.2 Middle Ming Wrecks:

Ko Si Chang III (1460 - 1487 CE):[217]

Metal objects recovered from this wreck comprised over 2000 lead ingots. Descriptions of the ingots are consistent with lead ingots found in the assemblage of the Royal Nanhai, (Fig. 3.11)[218] the Pattaya,[219] and the Ko Si Chang II wrecks.[220] Plano-convex shaped copper ingots

[215] One hundred and 167 individual coins and 1 concreted "stick" of coins. Over 20 is an estimation of the stick.
[216] Flecker 2001b
[217] For a full-itemized list of metallurgical artefacts, see Appendix 2.
[218] Brown & Sjostrand 2000, p.56
[219] Green et al. 1987, p.75
[220] Green et al. 1987, p.75

were part of the metallic assemblage of the Ko Si Chang III as well. Metal personal objects collected from the wreck include one lotus-shaped lead piece, a bronze phallus and a series of bronze lime pots.[221]



Figure 3. 11: Lead ingots or "bidor" from Royal Nanhai wreck.
(Brown and Sjostrand, 2000, pg. 56)

Lena Shoal (1488 – 1505 CE):[222]

Manufactured material such as cast iron bowls (Fig 3.12), copper repoussé wares (Figs. 3.13, 3.14) and wrought iron needles were part of the cargo situated below deck. Thirty brass spiral bracelets (Fig. 3.15) were also part of the trade cargo. Four bronze gongs (Fig. 3.16) and three *Hongwu* reign (1368-1398) coins were also catalogued as well as three bronze handguns (Fig. 3.17).[223] Raw material commodities of tin ingots (Fig. 3.18) and pig iron are also represented within the assemblage. [224]

[221] Green et al. 1987
[222] For a full-itemized list of metallurgical artefacts, see Appendix 2.
[223] J. Lopez-Martin in Goddio et al. 2002, pp.239–241
[224] Goddio et al. 2002, p.148



Figure 3. 12: Cast iron bowl from Lena Shoal. (Goddio, et al., 2002, pg. 236)



Figure 3. 13: Copper repousse' ware from the Lena Shoal. (Goddio, et al., 2002, pg. 242)



Figure 3. 14: Copper "beaker" from the Lena Shoal. (Goddio, et al., 2002, pg. 242)



Figure 3. 15: Brass spiral bracelet from the Lena Shoal. (Goddio, et al., 2002, pg. 241)



Figure 3. 16: Bronze gong from the Lena Shoal. (Goddio, et al., 2002, pg. 237)



Figure 3. 17: Bronze handgun from the Lena Shoal (~43cm long).
(Goddio, et al., 2002, pg. 241)

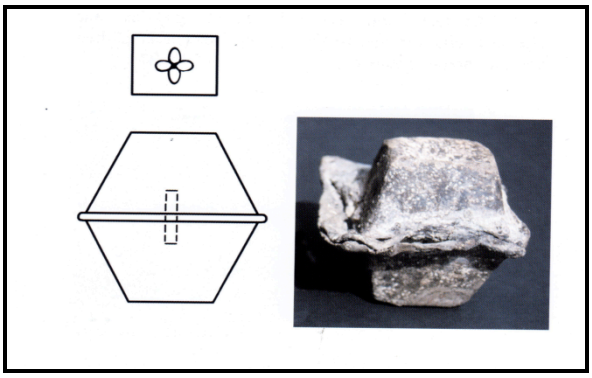


Figure 3. 18: Tin ingot sample (with floral rosette) from the Lena Shoal.
(Goddio, et al., 2002, pg. 248)

Santa Cruz (1488 – 1505 CE):[225]

The well-preserved wreck of the Santa Cruz yielded even more metallic material than the Lena Shoal. The accession inventory for the wreck noted one hundred and seventeen ingots of tin [226] as well as six sheets of copper, which were recovered from the Santa Cruz's hold and likely represent a cargo of raw materials. Twenty-two cast iron bowls—a tradable commodity—were also present. Also recovered during the excavation of the Santa Cruz were metallurgical artefacts for shipboard use. One cooking cauldron and one plate were recovered, along with thirteen net weights and three weighing scales. Twelve bronze gongs

[225] For a full itemized list of metallurgical artefacts, see Appendix 2.
[226] The ingots were improperly identified as "lead" during the artefact recovery. Spectrographic analyses of the ingots show that they are all in fact, tin. This will be explained later in the chapter.

were found in the cargo hold, along with several brass spiral bracelets.[227] The assemblage contained only three coins. Armament on the Santa Cruz consisted of six bronze handguns.[228] A metal box was catalogued in the assemblage as well. Perhaps most interestingly, the wreck yielded a unique bronze crown (Figs. 3.19, 3.20).[229]



Figure 3. 19: Bronze crown found on the Santa Cruz. (Brian Fahy)



Figure 3. 20: Zoomorphic icons on bronze crown from Santa Cruz. (Brian Fahy)

The various manufactured and raw materials found on all of the shipwrecks in this case study are tallied in Tables 3.3 and 3.4, respectively. The lack of manufactured material on the Turiang could reflect the rapidity of the recovery process, looting by the local community, a lack of interest in less than pristine or saleable material, or a simple lack of manufactured metallic material on the boat. It is also conceivable that the metallurgical assemblage had eroded and melded with the iron granules. It was estimated that nearly 30 per cent of the boats' cargo was lost due to looting.[230] Due to the sheer quantity of sherds found on the wreck, divers were probably using an airlift or similar vacuum extractor attached to a floating

[227] The artefact inventory catalogued one complete bracelet, along with one hundred and sixty four broken rings. Reconstruction of these was not possible, so I could only estimate brass spiral bracelet counts.
[228] The archaeological artefact inventory noted two iron barrels: one identified as a "sarbacane" or blowgun, and the other identified as a "gun barrel" as part of the Santa Cruz assemblage. They were not part of the assemblage at the National Museum of the Philippines. Either they were miscategorised, or this material became property of the HILTI foundation.
[229] Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996; Orillaneda 2012
[230] Brown & Sjostrand 2000, pp.16–17

screen to catch the smaller artefacts.[231] This should catch any smaller material, metallic or otherwise. Since these items were not found in the main excavation nor the sieve, the smaller metallic artefacts were most likely not present or had become part of the iron concretions in the cargo.

The metallic material on the Ko Si Chang III seemed to fare similarly to the Turiang. Besides the lead and copper ingots, few other metal artefacts were found. The ingots were not concreted together and given the high trafficked area that the Ko Si Chang III was found in, it is likely that items of this type were either not present or eroded in the environment. The Ko Si Chang III is also the smallest sized boat represented in this sample.[232] It has been suggested that the Ko Si Chang III was used for local coastal trade, due to its size and given the cargo manifest.[233] These factors could explain the lack of metallurgical items on the ship.

[231] As mentioned in Chapter 2. No details were noted on the methods of excavation or excavation footprint, besides the hull itself. See Brown & Sjostrand 2000.
[232] The estimated length of the *Ko Si Chang III* is approximately 11 meters long and 5 meters wide. The next largest boat in this case study was twice this length.
[233] Green et al. 1987

Shipwreck	Date	Coins	Gongs	Mirrors	Bronze bell	guns/cannons	Spearheads	Limepots	Fishhooks/ Weights	Personal Effects Jewelry	Misc.	Iron Pots	Copper Repousse'
Turiang	1370-1400CE												
Rang Kwien	1400-1430CE	x	x	x	x	x		x	x	x	x		
Bakau	1410-1430CE	x	x	x	x	x	x				x	x	
Ko Si Chang III	1460-1487CE							x			x		
Lena Shoal	1490-1505CE	x	x			x					x	x	x
Santa Cruz	1490-1505CE	x	x			x			x	x	x	x	

Table 3.3: Manufactured Metals on Shipwrecks

Shipwreck	Date	Tin Ingots	Lead Ingots	Iron Ingots	Copper Ingots	Iron Granules	Copper Sheeting
Turiang	1370-1400CE					x	
Rang Kwien	1400-1430CE				x		
Bakau	1410-1430CE	x					
Ko Si Chang III	1460-1487CE		x		x		
Lena Shoal	1490-1505CE	x		x			
Santa Cruz	1490-1505CE	x	x	x			x

Table 3.4: Raw Metallurgical Material on Shipwrecks

Looking at Tables 3.3 and 3.4, we begin to see increased trading in manufactured and raw metallurgical material over time. Ships dated to the Middle Ming period (the Ko Si Chang III, the Lena Shoal, and the Santa Cruz) show an increased trade in tin, lead, and copper than during the Early Ming period. While ceramics are still in the majority on these vessels, it is easy to recognise the increasing popularity of a trade in metals. This also helps bolster the case that more studies need to be done on this form of material trade.

3.4 Object Biographies

As mentioned at the beginning of the chapter, the metal artefacts can be divided into those that were part of the cargo and the domestic assemblage. The cargo can be further subdivided into raw material and processed metals. Items that have an unknown role will be categorised as such. While the assemblage items could have been broken down strictly by element, (i.e. iron items, copper items), such a material-based typology would not have been as thorough as one that considers the use of the objects themselves. The ship reports and excavation collections in this case study have already been conducted. That level of detail contributes to the body of archaeology, but as Muckelroy states, "It is necessary to go beyond the individual and specific events enshrined in these entities, and look at the maritime culture in which they were embedded."[234]

Using a traditional, "by-material" classification method to analyse this collection would be deficient, specifically when dealing with metallurgical items. Any sort of taxonomic study of metals is complicated by the corrosion and recovery process. It is highly probable that metallurgical material excavated in a seawater environment has taken on concretions and/or undergone degeneration to a point at which the artefact looks profoundly different than before it sank. There are also few style and sourcing guides for the metallurgical material, particularly in Southeast Asia, which can be unfavourably compared to ceramic material,

[234] 1978, p.226

where the level of provenance detail that archaeologists and historians can attribute to ceramics is remarkable.[235]

The only comparable research to that undertaken in metals is Arsenio Nicolas' work on the taxonomic classification of bronze musical instruments excavated in Southeast Asia from the ninth through seventeenth centuries.[236] His work represents an important style guide for the material, and gathers many historical and ethnographic sources in the attempt to ascertain whether these instruments were fabricated in China, or, through some technical exchange via China, made in Southeast Asia. No local analytical studies of fishhooks, spearheads or net weights have been conducted. This is possibly due to a lack of archaeological material, the lack of preservation in situ or post recovery, or perhaps simply relative lack of interest in the material.

3.4.1 Manufactured Materials:

3.4.1.1 Definitive Commodities

Iron Pots and needles

Before we analyse the iron inventories of the shipwreck assemblages, it is important to understand what happens to iron artefacts while they are immersed in seawater. According to Roberge, the mean corrosion rate of iron and iron alloys is about 0.1 mm/year. While his focus is mainly on naval and nautical structures, this measurement applies to iron-based artefacts as well.[237] Depending upon an artefact's thickness (in this case, thin iron woks and minuscule needles which measure a few millimetres at their thickest), Roberge's corrosion rates predict complete degradation of these items within a few decades. Obviously, due to the fact that this material has been recovered, complete degradation is not always the case. Additionally, there are factors that can slow artefacts' rate of decay:

> For a ferrous metallic artefact, the decades which follow this involuntary immersion lead, simultaneously or consequently, to the formation of a thick layer of concretions– also called 'gangue' – made up mainly of corrosion products, micro and macro fouling and sediments…(A)s far as corrosion is concerned, the thickness and compactness of this gangue play an essential role, acting as a barrier against the diffusion of the dissolved species towards the metal surface, and slowing down the

[235] As described in Chapter 2.
[236] Nicolas 2009
[237] Roberge 2012, p.141; Memet, J.B. 2007

ionic transport through the corrosion products onto the metal surface, thus notably reducing its corrosion rate.[238]

Chemically speaking, the iron undergoes anodic and cathodic reactions on its surface. Since the metal's matrix is made up of various elements (some more anodic than others: see Table 3.2), corrosion begins in the weaker section of the surface and spreads from there. The anodic reaction between the iron and the aerobic seawater environment is as follows:[239]

$$Fe \rightarrow Fe^{2+} + 2e^{-}$$

The cathodic reaction is:

$$O^2 + 2H_2O + 4e^{-} \rightarrow 4OH^{-}$$

The full thermodynamic reaction begins to create ferrous hydroxide on the iron's surface:

$$Fe^{2+} + 2OH \rightarrow Fe\,(OH)_2$$

This creates an unstable hydroxide state that pits the surface of the metal, thus allowing for deeper diffusion of oxygen into the piece. Eventually the reaction stabilises on the surface, resulting in a layer of rusty, brown corrosion.[240] The dissolved oxygen underneath the rust layer grows into a layer of magnetite (Fe_3O_4), sandwiched between the iron substrate and the corrosion layer.[241] The layer of magnetite slows the corrosion process by varying degrees. In combination with other preservation factors, like sediment site coverage, wave turbulence and water temperature, this allows for the recovery of some iron-based objects.

Cast iron pots were identified in the assemblages of the Bakau, the Lena Shoal and the Santa Cruz. The volume of pots recorded from these wrecks points to a trading practice in cast iron wares from the late 14th Century to the late 15th Century.[242] Large quantities of these 'woks' have also been found on the San Diego,[243] Investigator Shoal and the Breaker Reef wrecks.[244] Michael Flecker identified a trio of cast iron bowls found on the Intan wreck, a 10th century

[238] Roberge 2012, p.157
[239] The electrochemical reaction in an anaerobic environment would be different due to the lack of oxygen in the system. Since all of the wrecks are in an aerobic environment, anaerobic reaction will not be discussed.
[240] Ferric hydroxide corrosion chemically undergoes initial changes into unstable greenish coloured corrosive layers due to constant bombardment of oxygen. See Olowe et al. 1989.
[241] Memet, J.B. 2007; Roberge 2006
[242] Both Flecker 2001b and Goddio 2002, p.235 identify "stacks" of cast iron pots in the holds of the respective shipwrecks.
[243] Goddio 1988
[244] Goddio et al. 2002, p.235

vessel found off the coast of Indonesia in the Java Sea.[245] It may be that some of these were used as cookware on the boats themselves; it is difficult to distinguish through the archaeological reports whether the artefacts were isolated utilitarian pots or trade goods.[246]

The similarities between the pots from these wrecks highlight a well-established cast iron trade between China and Southeast Asia. Although there are large iron deposits running from peninsular Southeast Asia through Thailand and Vietnam, as well as deposits in Luzon, no smelting technology in the region was capable of mass-producing this type of material or matching the competitive trade costs set by China from the 10th through 15th century pre-Ming ban.[247]

Cast and wrought iron production has been extremely well documented in Chinese history and archaeology. Guangzhou appears to have had a long tradition of iron smelting, and had the most large-scale iron production facilities during this time.[248] Donald Wagner notes a key Qing Dynasty text that describes the large-scale manufacture of cast iron woks in Foshan, China:

> After smelting at any of the smelters, all of the iron is shipped to the port City of Foshan, where the people are excellent founders. Of the woks which they produce the largest are called *"tang wei"*["sugar pot"?], "deep-seven", "deep-six", "ox-one", and "ox-two". The smallest are called "ox-three", "ox four", and "ox-five". If there are five to a bundle they are called "*five-kou*", and if there are three to a bundle they are called *"three-kou"*. Those without handles are called "oxen"…After [a wok] is cast it is coated with yellow clay and pork fat [to prevent rust].
> When [a wok] is struck with a light stick, if it [sounds] like wood then it IS good. It sounds like wood because its substance is 'hard'. Thus the woks of Foshan are expensive, because they are 'hard', and those of Shiwan (in modern Boluo County, Guangdong) are cheap, because they are brittle. 'When they are sold [as far away as] central China, people can distinguish them by their thinness and smoothness; the foundry work is refined, and the craftsmanship is accomplished. Foundry products are generally better in Foshan, while ceramic [products are better] in Shiwan.[249]

[245] Flecker 2002a surmises that the isolated finds are most likely crew use material.
[246] If the excavation reports are available, one could isolate the iron pots that were located away from the stacks and possibly analyse crew-usage pots vs. commodity pot patterns. Depending upon how many is found apart from the bulk items, it may yield some information.
[247] Flecker 2001b
[248] The Guangdong facilities were at their largest during the Ming and Qing dynasties. It is unknown as to the scale of production during the Song and Yuan dynasties. If the "woks" from the Intan wreck can be traced to Foshan, then the region was likely fabricating cast iron materials there since the 10th Century.
[249] Wagner & Wang 2008, pp.48–50 Here Wagner is citing a translation of a passage on iron smelting by late Ming scholar Qu Dajun's 屈大均(1630-1696) "Discourses on the Province of Guangdong".

It is possible that the cast iron woks recovered from the wrecks in question were manufactured in Guangdong province, China. Guangdong seems to have had the largest cast and wrought iron operations during the Ming Dynasty, though more data would need to be collected to ascertain the woks' exact provenance. The cast iron pots from the Lena Shoal and the Santa Cruz provide some supportive evidence that the Chinese port of call was most likely Guangzhou. Major export cities of blue-and-white porcelain were the Ming cites of Hangzhou, Quanzhou and Guangzhou. The cast iron shipments out of Guangzhou, paired with large exports of blue-and-white porcelain from Jingdezhen lend credence to that theory. There were no identifiable Chinese ceramics in the assemblage from the Bakau wreck, however, possibly due to extensive looting of the site or the prior unloading of any tradable Chinese ceramics.[250]

The wrought iron needles found on the Lena are a singular occurrence in this study. They were located inside a blue-and-white porcelain vase. Wrought iron is fabricated differently than cast iron. Wagner describes the crucible smelting process in Shaanxi province:

> The iron smelter is situated on a slightly inclined floor, 2 1/2 m long and 1 1/2 m wide. On the two long sides are walls, 4 m high; the third side, towards which the floor ascends, is open; and on the fourth is a small and primitive hut for the bellows and two people who work it. The floor is covered with small pieces of anthracite, the size of a fist. On this are placed about 150 crucibles of refractory clay, which are filled with a mixture of small pieces of anthracite and crushed iron ore. All the spaces between crucibles are carefully filled out with anthracite, and a layer of the fuel is spread on top. Sometimes a second layer of 150 crucibles is laid over the first. Over this is laid more anthracite and on top a layer of shards of old crucibles. The whole heap is ignited, and air is blown in. When everything is burning and the heat is great, the blowing is stopped, since the natural draught is sufficient to maintain the heat.
> If the intention is to make cast iron the crucibles are taken out after a certain period of time and the contents cast as flat plates; the result appears to be a clean white steelmaking pig iron. If wrought iron is desired, the heap is allowed to burn out and cool off over a period of four days. The crucibles are then taken out and broken. In this case the iron is in the form of a hemisphere.[251]

The process described here—the crucible technique—is one of a few processes used to fabricate wrought (and cast) iron. An earlier account of iron fabrication in Shaanxi province notes that a "puddling" technique was the accepted norm for the creation of both iron ingots

[250] Finding absolutely no Chinese ceramics or ceramic sherds, yet there are other Chinese artefacts present within the assemblage, tends to support an unloaded cargo.

[251] Wagner & Wang 2008, p.41 Wagner is paraphrasing Ferdinand von Richtofen in *Baron Richtofen's letters to the Shanghai Chamber of Commerce from 1870-1872.*

and wrought iron.[252] A mortared furnace was constructed complete with a "windbox" (bellows) and an open "valve" near the bottom of the furnace. The valve was fully loaded with iron ore and a heating fuel (wood, coal or charcoal). It was then sealed with clay and the furnace was lit. After a set time, when the iron had achieved a liquid state and most of the impurities were boiled off, the valve seal was broken and molten iron flowed out. The molten iron was then either poured into bar shaped casts, which when set becomes cast iron, or taken to a pool filled with water (Fig.3.21) The iron was poured into the water and mixed with saltpetre to accelerate the oxidation process and strengthen the iron to form wrought iron.[253] Items made with wrought iron were both tougher and more malleable than cast iron pieces. In China, smaller manufacturing centres were responsible for the creation of small wrought iron metal wares in this fashion.[254]

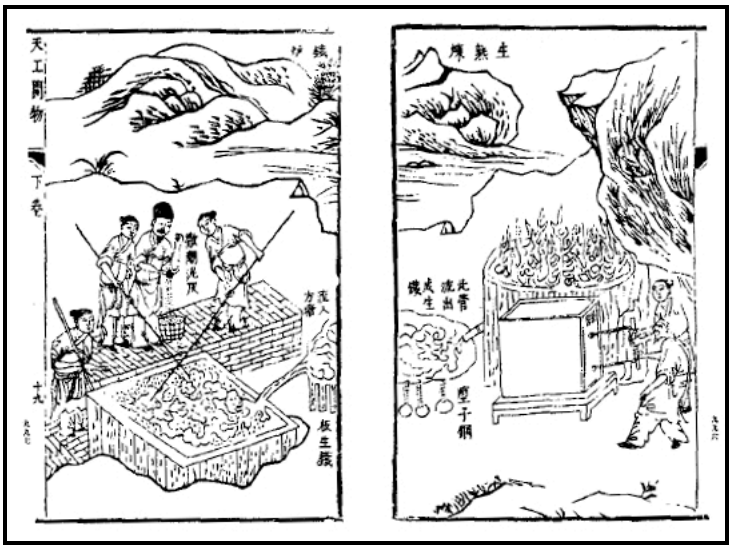


Figure 3. 21: Chinese account of "puddling" process to manufacture wrought iron. Left panel shows the immersed molten iron in a water pool, the right is the blast furnace where it came from. (Wagner, 2008)

The needles on the Lena Shoal were packed in a small blue-and-white box, along with many other blue-and-white ceramics inside a larger blue-and-white urn.[255] Their provenance certainly seems to be China. Since this is an isolated occurrence, not only within the cargo of the Lena Shoal itself, but also in the larger study of shipwrecks it raises a question about individual orders. This bundle of needles was in one vessel among thousands. Did a specific person request them? If so, what was the process for identifying specific orders, and what

[252] Wagner & Wang 2008, p.48
[253] Wagner,2008, p.345, citing Chinese scientist Song Yingxing (宋应星)in Tian Gong Kai Wu (天工开悟), 1637.
[254] Goddio 2002, p.236, citing Song Yingxing's Tian Gong Kai Wu.
[255] Goddio et al. 2002, p.236

was the process for delivery? Could this be that the whole of the blue-and-white cargo was promised to one individual, and if so, whom? It is also entirely plausible that it could have been a mistake as well. It was such an insignificant piece of the shipment; a group of needles could have been overlooked and accidentally placed (or left) in the vessel. In any case, it raises questions into how multiple merchants differentiated their cargo apart on these shipping vessels.

Wooden delivery slips were found and preserved from the Taean Maedo1, a Korean, Goryeo-era shipwreck. Senders and recipients of certain parts of the cargo were written on these slips, which were attached to wooden "cages" that surrounded a group of ceramics.[256] Delivery orders like this were not found aboard the Lena Shoal, or any other wreck in Southeast Asia. This one small item evokes many large questions, and is a mystery deserving of further study.

Copper Repoussé' Wares

Copper and copper alloy material (brass and bronze) fare much better than iron when immersed in seawater. Since copper (and its alloys) is relatively toxic toward certain microorganisms, items containing this element are generally found on wreck sites with little to no concretions on them. Any corrosion on this material can usually be attributed to the proximity of a more ferrous material in the environment. When corrosion does occur, it is usually in the form of tenorite (CuO), cuprite (Cu_2O) or nantokite (CuCl).[257]

The copper repoussé wares represent a significant mystery, one that demonstrates the lack of scholarship on the historiography of this artefact. Little study has been done on its typology and no image catalogues exist at present. Of the six wrecks studied, this material was solely found on the Lena Shoal. In the publication of the Lena Shoal wreck, Goddio suggests that this material may originate in Malaysia due to their stylistic decoration.[258] John Miksic, an expert on the Majapahit Empire (1293 CE – 1527 CE), adds that these wares could either come from Java or Sumatra as well. Similar beakers (Fig. 3.14) are known to exist in brass/bronze in Java and Bali from the 14th and 15th centuries. The chain work in Figure 3.12 is common from southern India, Indonesia to Borneo.[259]

[256] Yang 2011
[257] Memet, J.B. 2007
[258] Goddio et al. 2002, p.242
[259] Singapore 1995; Miksic 2013

Given the isolated instance of this material, it is something not widely traded and therefore unique to the Lena Shoal wreck. It is assumed that if this material was produced on the Malay Peninsula, similar material should show up in terrestrial excavations of sites from the Ayutthaya and Majapahit kingdoms. Since this is not the case, the trade footprint is smaller than originally thought and likely to be localised to Sumatra, Java, Borneo and Bali. It is possible that Indonesian excavations and museum catalogues offer more insight into products like this, but more research is needed. The National Museum in Manila houses the collection of the Lena Shoal, but only a few of these pieces are on display. The bulk of the copper repoussé wares are property of the HILTI Foundation and stored in Switzerland.

Brass Bangles (Armbands)

These objects are exclusively associated with the assemblages of the Lena Shoal and the Santa Cruz. X-ray spectrographic analysis of one of the brass armbands revealed an element makeup of:[260]

79% Copper
19% Zinc
4% Tin

The zinc/tin ratio is what identifies brass from bronze. Wares that have a high zinc percentage are identified as brass, while those with a high tin percentage are bronzes. As mentioned previously, copper and copper alloys are relatively high on the galvanic table, therefore they tend to corrode at a slower rate than other metals. Given that tin is a more noble metal than zinc, on par with copper on the anodic table, brasses tend to undergo "de-zincification" and therefore corrode faster when compared to bronzes. Goddio suggests that these bangles may come from the Malaysian peninsula due to its proximity to copper mines.[261] However, no copper sources exist in Malaysia on Higham's map of Southeast Asia's copper and tin sources (Fig. 3.22). Most of the copper sources are located within Thailand in the Loei-Petchabun Volcanic Belt.[262]

Currently, Malaysia's sole copper mine is not located on the continent. The source is in Sabah, East Malaysia, which was not part of the Malacca Sultanate in the 15th Century (Fig.

[260] Goddio et al. 2002, p.265
[261] Goddio et al. 2002, p.265
[262] Pryce et al. 2011

3.23).[263] Continental sources for zinc are located in Western Thailand and the Shan state in Myanmar. Copper and zinc are also located in Northern Sumatra.[264] Malaysia is abundant in tin, which could support a bronze smelting industry with the importation of raw copper. It may not be too great a journey to import both copper and zinc to produce brass items. Thailand seems to possess sufficient quantities of copper and zinc sources, which may bolster the theory that the Ayutthaya Kingdom could have had a brass/bronze making production centre. The bangles, like the copper repoussé vessels, may also be a product from the Majapahit Empire. Further stylistic study would be needed to truly understand where this type of artefact comes from, and where it was commonly traded.

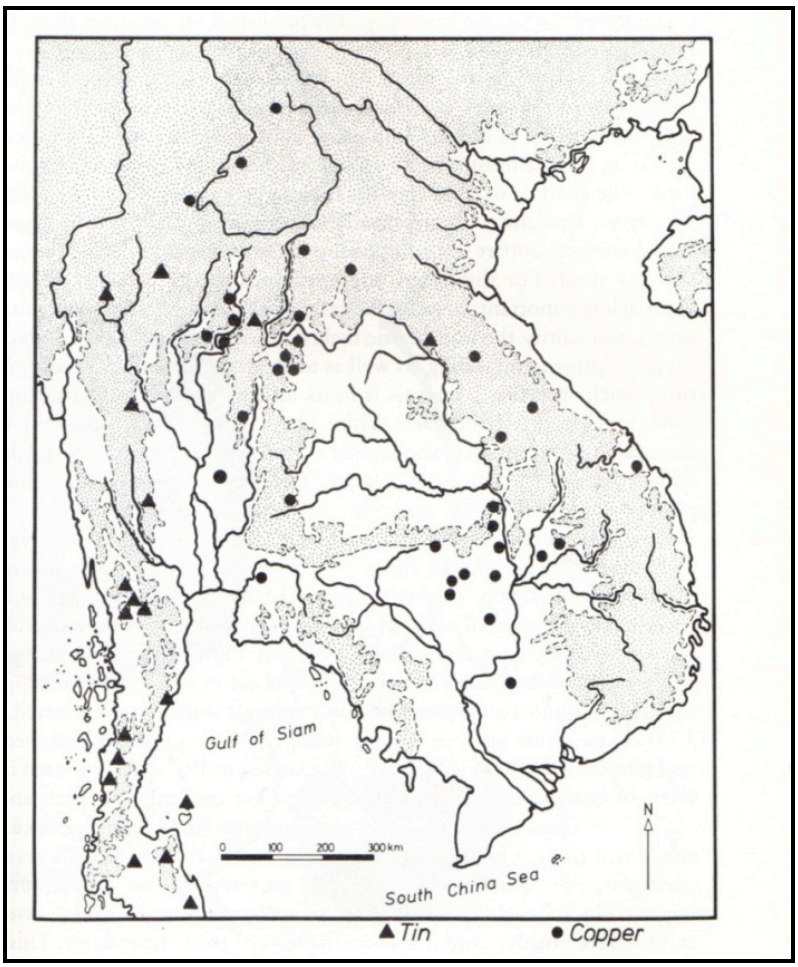


Figure 3. 22: Sources of tin and copper in Peninsular Southeast Asia. (Higham, 1989, 143)

[263] Japony & Togkul 2009
[264] Widajatno & Irwandy 2011



Figure 3. 23: Map of Malacca Sultanate (1400-1511CE) (Gunawan Kartapretata)

Thirty bangles were catalogued in the assemblage of the Lena Shoal, along with a series of fragments from the Santa Cruz inventory. While at the National Museum in Manila, I was only able to account for two bangles, both from the Lena Shoal wreck (Figs. 3.24, 3.25). The remainder of this material was unaccounted for.[265] It is possible that some of them are in the stores of the HILTI Foundation.

[265] Most of this material from these wrecks was most likely donated to the HILTI Foundation. A re-inventory of these assemblages is planned in 2016.



Figure 3. 24: Brass bangle from the Lena Shoal. (Brian Fahy)



Figure 3. 25: Brass bangle from the Lena Shoal. (Brian Fahy)

Bronze Gongs, Mirrors and Tweezers

Seventeen gongs were found on the Bakau wreck, four gongs were recovered from the Lena Shoal and twelve from the Santa Cruz (Fig.3.26). The quantities of bronze gongs on these ships lead to the conclusion that these are traded cargo. Though the gongs on the Bakau and Santa Cruz are fewer in number than those from the Lena Shoal, the archaeological report notes that the gongs were grouped together; this also tends to suggest a cargo item.[266]

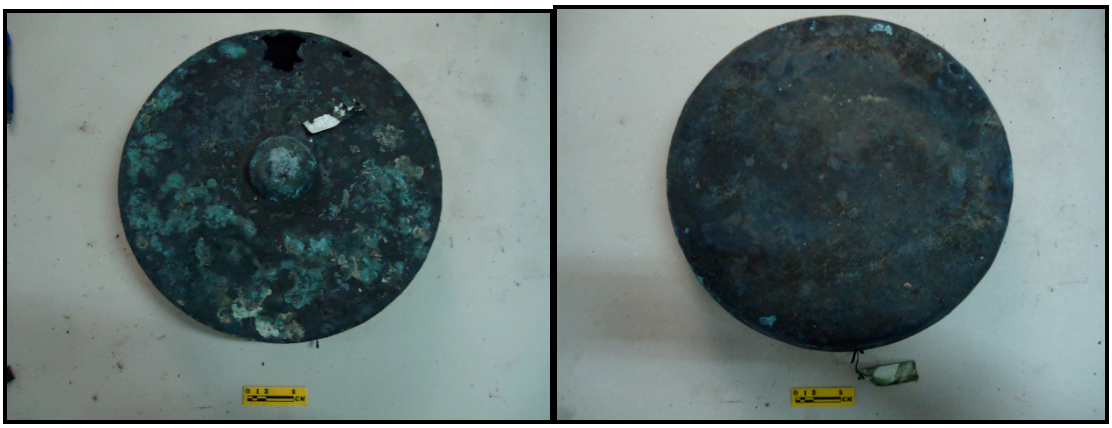


Figure 3. 26: Bronze gong from Lena Shoal (left) and Santa Cruz (right). (Brian Fahy)

Bronze mirrors were found on the Bakau wreck in substantial quantity (~10). The mirrors and their respective handles were observed as being "detached" from each other. Whether this was a loading choice, breakage during the wreck or the effect of corrosion/deterioration is unknown.[267] In every case, their numbers are not nearly as prolific as traded ceramics, but in that regard they hold a higher place due to their potential expense. It is a specialised

[266] Goddio et al. 2002, p.39
[267] Flecker 2001b

commodity, possibly given/sold to only the most discerning of consumers. Isolated instances may raise the issue that some were not cargo.

One single mirror was found in the assemblage of the Rang Kwien. Found attached to the keel of the boat, it has been suggested that this was a common practice by Chinese sailors to prevent disaster.[268] Its role within the boat, most likely makes this personal property of someone on the vessel and not a traded good. Depending upon where it was found in the keel, it is also plausible that the mirror rig could have been used as a signalling device. More study is needed to understand any mystical or practical connotations of its placement on the Rang Kwien.

It is possible that individual bronze gongs on these boats served as part of the ships' equipment or crew possessions. Contemporary ethnographic studies documented the playing of these instruments in sets (three to seven gongs) in certain parts of Indonesia.[269] However, the methods of playing the gong (or gongs) in East and Southeast Asia varied throughout history; therefore it cannot be assumed that they were played in a set.[270]

Six sets of bronze tweezers were in the assemblage of the Bakau. They were found packed together during the excavation, therefore we can assume that the objects were a traded commodity.[271] More of these may have been in the cargo, but their small size could have made them both hard to find, and/or hard to survive the oceanic environment. An item like this represents a highly valued object, much like the bronze mirrors found within the assemblage. These two artefact types pair well together. A mirror would be necessary if a user desired to preen with a pair of tweezers. If we treat these objects (mirrors and tweezers) as a "set" of artefacts, they could promote discussion about concepts of grooming and vanity during this age, as well as debate on the cultural transfers on ideas of beauty and the exotic.[272]

Coinage

All of the coins found in the sample of wrecks under investigation were bronze coins from China. No other metallic currency was present. Isolated occurrences of coins were found on the Bakau,[273] Lena Shoal[274] and Santa Cruz[275] wrecks and so it is more than likely that the

[268] Elisseeff 2000, p.188; Intakosai 1983
[269] Nicolas 2013b
[270] Nicolas 2013a
[271] Flecker 2001b
[272] Morrison 2013
[273] Flecker 2001b

coinage on these vessels were property of the sailors, merchants and passengers. Only on the Rang Kwien wreck do the coins actually represent a significant percentage of the assemblage. As mentioned previously, the excavators recovered over four thousand coins from the wreck.[276] The coins that were recovered were minted over a wide time span and loaded into Chinese ceramic jars.[277] Given the quantity and the position of these items within the wreckage, it is likely that the coins on the Rang Kwien were a commodity.

It is not necessary to depict the foundry methods or to attempt to glean the port of lading using this material. Since coinage was traded throughout China, it could have been from any coastal port there. Recirculation of Chinese coins was a common practice, which explains why this specific assemblage from the Rang Kwien covers coins minted from the fourth through fourteenth centuries.[278] It is also a widely accepted form of currency throughout Southeast Asia and, therefore, cannot give much information about its final destination. Other than the coins the Rang Kwien wreck did not have a great deal of additional cargo. There were several pieces of Vietnamese and Thai ceramics; other than that, nearly everything else was Chinese.[279] This lack of artefactual evidence means that it is possible that the Rang Kwien did not obtain any other items of cargo at ports along its route.[280] It could be that the whole of the cargo was to be unloaded wherever it was headed, due to its geographical homogeneity. In the same vein, the Rang Kwien may have been a "start-up" ship; a source of funding for an expatriate Chinese community financed by a wealthy Chinese trading family. Textual and archaeological evidence reveals a long history of Chinese overseas settlements.[281] This procedure may be a common one to instantly fund a company or community outside of China. No other Southeast Asian wreck has yielded such an assemblage and there are no historical references to this practice, therefore it is complicated to surmise the operations and intensions of such a vessel. 28 tons of Chinese coins were found on the 14th Century Shinan wreck in Quanzhou, China. This was assumed to be

[274] Goddio et al. 2002, p.247
[275] Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996
[276] Estimates are unknown as to how much may have been lost to looting.
[277] Intakosai 1983
[278] Intakosai 1983
[279] Green & Harper 1983See Chapter 2.
[280] That is not to say it did not stop for supplies. It may have followed the coastline and provisioned in various entrepots before making its way to its final destination.
[281] Chang 1991; Ptak 1994

material scheduled to be melted down and reused for other projects.[282] The coinage from the Rang Kwien could have been destined to have the same purpose.

Bronze Crown

A bronze crown was recovered from the Santa Cruz (Figs. 3.27, 3.28).[283] There are a number of triangular recesses in the ring base, which perhaps may have held flowers or feathers. A series of animal figures ring the top of the crown; elephants, monkeys, a squirrel and what appear to be lions with wings. All of the animals on the crown are of sacred reverence in Hindu mythology. We cannot provenance an item like this, but the Hindu elements of the piece suggest that it comes from an area where Hinduism was important at the time. Champa had deep connections to Hinduism since the seventh century but the popularity of the religion waned from the tenth century upon the introduction of Islam. The state religion was officially changed to Islam in 1471 CE.[284] This paired with the fact that no Champa ceramics were recorded from the Santa Cruz make this an unlikely embarkation or debarkation port.

Dynasts in Dai Viet had shifted from Buddhist connections in the 1460's and adopted the Confucianist ideals and values it had observed from China.[285] Hinduism never had a strong hold in the region. There is little representation of Vietnamese ceramics on the Santa Cruz to corroborate the concept of a tramping port of call in Hoi An. Smaller Hindu communities were located in Java, Bali and Sumatra in the late fifteenth century.[286] Ayutthaya during that time identified with Buddhist traditions.

[282] Green 1983
[283] Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996
[284] Chapuis 1995, p.46
[285] Whitmore 2009
[286] After the Majapahit Empire fell, most of the region quickly embraced Islamic doctrine. The old Majapahit line moved to Bali, keeping the island connected to Hinduism. See Fic 2003, p.110

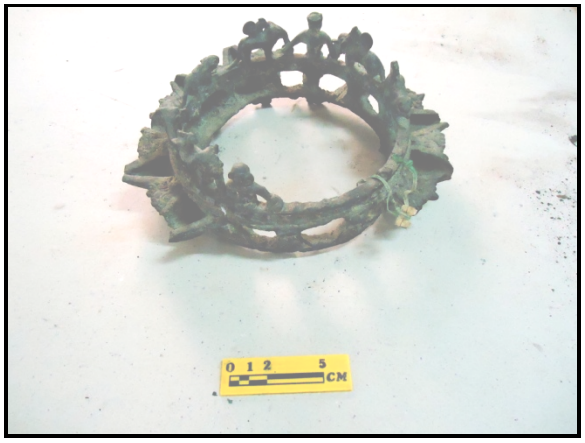


Figure 3. 27: Bronze crown recovered from Santa Cruz. (Brian Fahy)



Figure 3. 28: Bronze crown from Santa Cruz. (Brian Fahy)

The crown is a unique item. It was found with a large amount of ceramics, suggesting that it was packed with the cargo. An item like this was probably not a commodity, but it is possible that this item was intended as a gift, or was a specific commission from a wealthy patron. Since the Santa Cruz wrecked in the Lingayen Gulf in the north of the Philippines, it is possible that the route of the boat (and the eventual destination of the crown) may have taken it down the Palawan Coast, towards Hindu havens in Indonesia.

3.4.1.2 Ship Use/Personal Metal Wares

Fishhooks and Net Weights

Bronze fishhooks were found in the Rang Kwien[287] and the Bakau[288] assemblages. One net weight was recovered from the Bakau and a handful of lead weights were catalogued in the assemblage of the Santa Cruz.[289] Obviously, this points to fishing practices on the boat. It would be foolish to think that fresh fish would not be a part of the sailor's diet.[290] The use of bronze material shows that maritime cultures in the region were aware of copper and copper alloy corrosion-resistance properties. Lead is also high on the anodic index, and preserves rather well (the circumstances surrounding corrosion of "white" metals like tin and lead will be discussed later). It cannot be said that they used these materials exclusively; small iron artefacts may have corroded entirely and not been identified or recovered.

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[287] Intakosai 1983
[288] Flecker 2001b
[289] Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996
[290] Archaeological evidence certainly corroborates this in this specific case study. Piscifaunal analysis will be discussed in Chapter 4.

Fishhooks and net weights are not often published in papers or catalogues. Where they are mentioned, it is usually as an aside in published work.[291] Certainly in some cases, there is little to comment on and they may be too corroded or unrecognisable. Many reports comment on finding "small lumps (or chunks) of metal", which is nearly impossible to identify.[292] Yet some are identified and surely come out of the water in a recognizable condition. Items like these present another opportunity for future research. A typological study, combined with ethnographic research in the manufacture and trade of these objects in the area may yield great insight into cultural connections and boats within Southeast Asian communities.

An attempt was made to document fishhooks and net weights while conducting fieldwork, which had varying degrees of success. The Underwater Archaeology Department in Chanthaburi, Thailand housed material from the Rang Kwien and Ko Si Chang III wrecks, but contained no fishing equipment. The Bakau wreck was housed in the Experiential Museum in Singapore, where I was able to document the fishhooks (Figs. 3.30, 3.31), and the net weights.



Figure 3. 29: Fishhook from the Bakau wreck. (Brian Fahy)



Figure 3. 30: Fishhook from the Bakau wreck. (Brian Fahy)

Sounding Weight

A bronze sounding weight was identified as part of the Bakau wreck.[293] Green catalogues a lead "object" received from the Ko Si Chang III wreck, which although he does not make a judgement on this, I would suggest that this item could also be a sounding weight.[294] Given

[291] Flecker 2001b
[292] Liow 2013
[293] Flecker 2001b
[294] Green & Harper 1983, p.75

the similar profile lines of the Bakau and the Ko Si Chang III objects they may be the same type of artefact. Again, we see crew-use materials that have a strong corrosion resistance. Since they have a higher corrosion resistance, they have a higher chance of survivability in situ than similar items made of iron. We cannot presume that all sounding weights are made of either bronze or lead. It should be noted that each object is relatively ornate, and a sounding weight would not need to be so decorative. A similar item was found in the Longquan wreck, a 15th Century vessel excavated off the East coast of peninsular Malaysia.[295] It is possible that this is a very significant item on the boat, entrusted to a respected and knowledgeable individual. Who or what owns this item? The boat? The captain? The sailor whose job it is to collect depth soundings? Does its "ornateness" give it a mystical or reverent function? While this information is readily available in the epigraphic studies of the classical world, similar studies have not been conducted on Southeast Asian nautical artefacts.

Comparative studies in sounding weights have been undertaken for the Mediterranean Sea during the Greco-Roman period.[296] Many of the examples Oleson shows are less ornate in shape yet serve a dual purpose (Fig. 3.32). The weights identified in the Mediterranean serve as depth weights but also have a "tallow cup" in the bottom of the housing. The "cup" is a recessed cavity in the weight, which serves the purpose of testing the sediment at the bottom of the body of water being traversed to gauge nearby river mouths or known underwater geological phenomena.

[295] Brown & Sjostrand 2000, p.51 The object is identified solely as a "weight".
[296] Oleson 2008

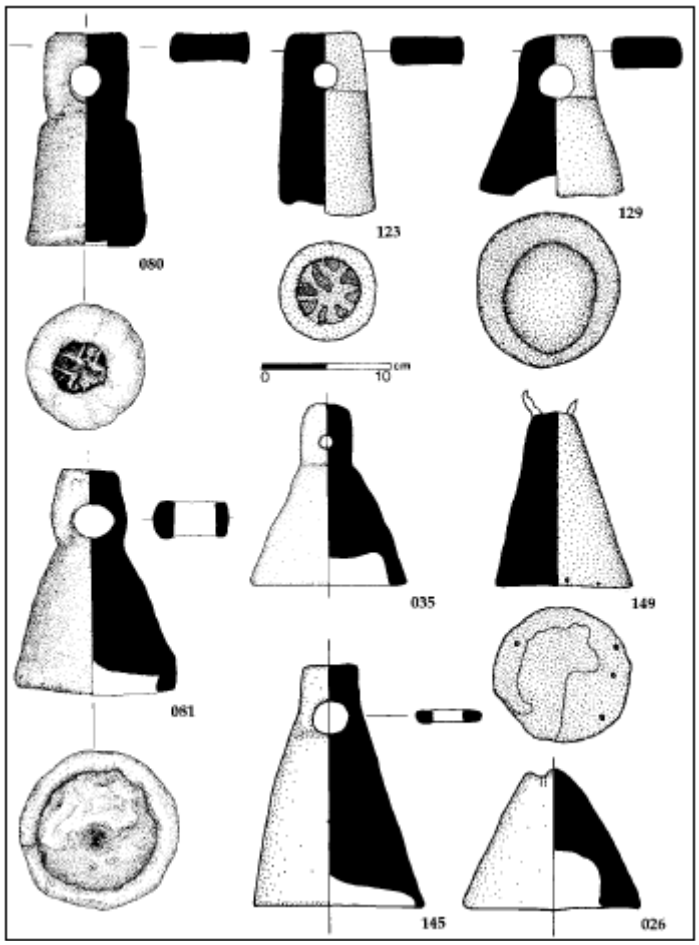


Figure 3. 31: Ancient Greek sounding weights. (Oleson, 2008)

The assumed sounding weight from the Bakau has no tallow cup (Fig.3.33). Yet a sounding weight has a good deal of use in the area, specifically if boats like these were traversing up the Chao Praya or Mekong river deltas to directly trade with the Ayutthaya and post-Angkor kingdoms. At present there is no wider comparative Southeast Asian evidence on the presence and practice of these items. It is also conceiveable to suggest that this may not have been a sounding weight, instead a weight for a pan or scale. Metal scales were not recovered from the Bakau, but scales were commonplace on boats at the time for use in trade and cooking.



Figure 3. 32: Sounding weight from the Bakau wreck.
(Brian Fahy)

Bronze Amulet

A bronze, phallus shaped amulet was recovered from the wreck of the Ko Si Chang III.[297] Also known as a "palad khik", the Thai penis amulet is used to ward off evils and ensure good luck. It is not a specific nautical spiritual tradition; it is largely (still) practiced in Thailand.[298] This artefact could not be located during my fieldwork visit and so could not be documented.

Weaponry

Handguns

According to Flecker, a "number" of small guns were recovered off of the Bakau wreck.[299] During my visit to the Experiential Museum in Singapore I documented two guns (of the ten accessioned) from the Bakau (Figs. 3.33, 3.34). Five guns were part of the Lena Shoal[300] assemblage and four were recovered from the Santa Cruz (Figs. 3.35, 3.36, 3.37)[301] One of the guns described on the Bakau (Fig 3.35) is similar to one found on the Lena Shoal. As

[297] Green & Harper 1983
[298] Freeman 1977
[299] 2001b
[300] Goddio et al. 2002, pp.240–1
[301] Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996"

Flecker describes, "[they] have a bulbous powder chamber with a protruding hollow section behind for inserting a wooden handle or tiller…Two examples also have a single integral loop handle spanning the powder chamber."[302]

The guns on the Lena Shoal show diversity in gun barrel design. One barrel is hewn off (Fig. 3.33; if it broke at the time of the wreck, its joining piece was not found) and one has a flared muzzle (Fig. 3.34). Three others have straight barrels (like Fig. 3.35). A stylistic study of these may reveal differences in munitions.[303] It is most likely that all of these items were part of crew armament. Mounted on the gunwales, the guns would have been used to repel pirate attacks. Archaeologically, they are relatively uncommon. These types of weapons have only been found on the Lena Shoal, the Santa Cruz, the Brunei wreck, the Pandanan wreck and the Ko Sdach wreck. These wrecks are all dated to the 15th Century, and all but the Ko Sdach wreck had sunk in island Southeast Asia.[304]



Figure 3. 33: Handgun from the Bakau wreck. (Brian Fahy)



Figure 3. 34: Handgun from the Bakau wreck. (Brian Fahy)

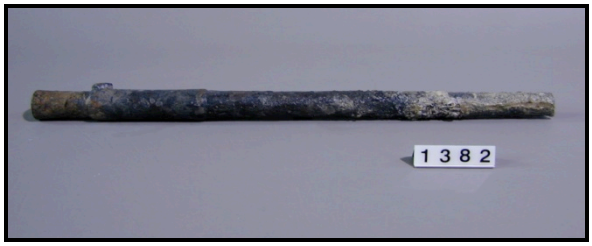


Figure 3. 35: Handgun from the Santa Cruz. (Brian Fahy)

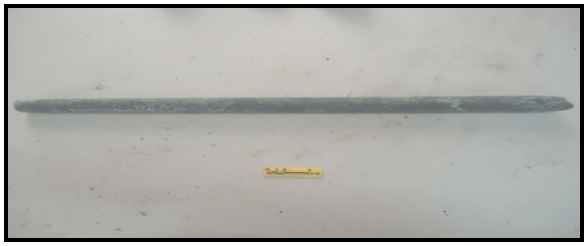


Figure 3. 36: Handgun from the Santa Cruz. (Brian Fahy)

[302] Flecker 2001b

[303] Javier Lopez (in Goddio, 2002) suggests that the dimensions of the guns point to them being incendiary dart launchers, but no citation of this evidence was given.

[304] The Ko Sdach wreck was found in Cambodia. (Tep 2014; Walker-Vadillo 2014)



Figure 3. 37: Handgun from the Santa Cruz. (Brian Fahy)

Spearpoint

Of the six shipwrecks examined, only one spearhead was found on the Bakau wreck (Fig. 3.39).[305] It also happens to be one of the most well preserved metallic items from the six shipwrecks. This can mean many things. It is possible that close quarter weapons were not perceived as needed on journeys such as these or simply that the spearheads (and wooden hafts they were attached to) did not survive long term immersion in seawater. Due to the lack of similar material on other wrecks, this was most likely not commonly used as a tool for fishing. Yet if the possibility of pirate invasion was real and cannons were a viable deterrent for such a scenario, I would have assumed that a boarding prevention plan would be in place and would facilitate the need for close quarter weapons like swords, knives and spears. No knives or swords are assessed in this case study, since those materials either were not found during the excavations, or did not preserve well enough in seawater.



Figure 3. 38: Spearhead from the Bakau. (Brian Fahy)

[305] Flecker 2001b

Tsuba

Although this item was identified as a mirror handle in the assemblage of the Rang Kwien, I believe this actually to be a Japanese Tsuba, or handguard for a Japanese sword (Fig. 3.29). Tsubas were interchangeable. They were switched out on the blade depending upon the function of the blade (i.e. where the sword was worn, either the court, or the battlefield or for a social function) and the attitude of the sword carrier at the time.[306]



Figure 3. 39: Japanese "Tsuba" from the Rang Kwien. (Brian Fahy)

Given the cargo of a large amount of coins on the Rang Kwien ship, it is largely possible that an armed escort was employed along the voyage for protection. This could be from one of the soldiers or mercenaries that were hired to protect the ship from brigands or it could very well be a brigand's tsuba as well. The significance of this artefact along with the wealth found on the ship enriches the narrative of the Rang Kwien.

3.4.2 Metallic Raw Material

3.4.2.1 Iron

Iron granules

Iron in granular form was recovered from the wreck of the Turiang.[307] The granular iron bags were placed on top of the Thai ceramics. This placement acted as a method of securing the ceramic cargo. In terms of cargo manipulation, it could be suggested that the iron was picked up either in conjunction with or sometime after the loading of the Thai cargo. It is possible that the iron was removed from the hold, the Thai ceramics were then placed in and the bags

[306] The Smithsonian Institution's National Museum of Design 1980
[307] Brown & Sjostrand 2000, p.14

of iron put back on top, but this seems unlikely given where iron rich sand is found in Southeast Asia. This raises the question of what was the intended destination of the iron. If this material did not come from China, would an iron-rich country like China need this cargo? Is it simply being used as a commodity along its voyage?

Large deposits of high-grade iron ore are found in Luzon, the Malay Peninsula and along a belt running from northern Thailand through Laos to northern Vietnam and China.[308] Small mines in Sulawesi are thought to have produced a nickel-rich iron that was used in manufacturing krises (Indonesian daggers with a wavy blade) prized in Java, but archaeological evidence is yet to be found for production during the Sunda Kingdom (14th and 15th centuries).[309] Java is known to have large deposits of magnetite sands along its southern coast, which were perfectly suitable for early smelting, and yet there is no indication that Java ever produced iron. It was all imported.

China produced vast quantities of iron and, through economies of scale; it seems that they could readily compete with local producers. This was achieved through advanced technology rather than access to high-grade ore deposits.[310] But then, are there supply differences between the iron granules, wrought iron material and cast iron material? There has been little study on the historical use of iron in granular form. The bulk of research on this material has largely been on iron ingots and iron vessels, yet the scholarship on this as a whole is still quite thin.[311] This granular form of iron could be what modern mining companies call "iron sand", or "black sand". The material is completely comprised of grains of Magnetite (Fe_3O), and usually found in small quantities of river sand flowing out of granitic mountain ranges. Since magnetite is heavier than the quartz (SiO_2) sand it flows with, the black sand tends to settle in certain bends in the rivers. In its natural state, the sand in these areas can have as much as 7 per cent of iron in it. "Washing" the iron sand can yield a purity rate of 95 per cent.[312] Historical Chinese texts describe the processes to refine iron sand into its purest form. [313] Sand is either panned or a "sluice" is constructed to separate the magnetite from the sand (Fig. 3.40).

[308] Higham 1989, pp.190–1
[309] Miksic 2013
[310] Flecker 2002a
[311] Flecker 2001b; Flecker 2002a; Goddio et al. 2002, pp.235–6
[312] Wagner & Wang 2008, p.343
[313] Wagner & Wang 2008, p.340

It is possible that the process of refinement was taught to local Southeast Asian communities in the hopes of procuring this resource. It is also possible that Chinese communities within Southeast Asia were the parties in charge of obtaining iron granules. Again, since the scholarship is still lacking regarding certain Southeast Asian metallurgical practices we cannot ignore the possibility that local technical artisans knew this process of obtaining high-grade iron sand.

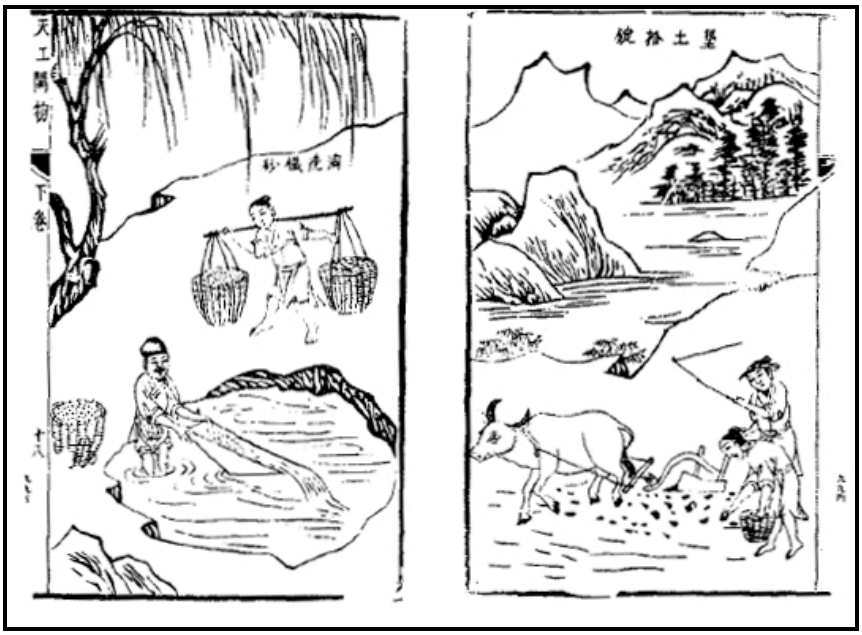


Figure 3. 40: Left panel depicting the panning of iron sand to separate it from the quartz. (Wagner, 2008)

There are high concentrations of iron sand deposits in Indonesia (Sumatra, Java)[314] and the Philippines (Luzon).[315] The magnetite mining operations in the Philippines are mostly offshore; therefore the iron bags of the Turiang, if they are in fact from Southeast Asian sources, most likely are coming from Sumatra or Java.

Iron Ingots

Ingots of pig iron were found on the Santa Cruz [316] and the Lena Shoal.[317] Goddio's assumption was that the role of the iron was two-fold. Due to their layout along the whole length of the ship, they acted as ship's ballast as well as tradable merchandise and resting along the centreline of the boat, helping it stabilise pitch and roll motions of the ship.[318] It is

[314] Yusgiantoro 2010
[315] Philippine Rural Reconstruction Movement n.d.
[316] Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996
[317] Goddio et al. 2002, p.235
[318] Ibid.

plausible to suggest that due to its cargo placement, at the bottom of the boat, along its length and under several tons of ceramics, that this material was loaded in the same port as the ceramic material. If the role of this material was to act as ballast and was not meant as an item for trade, then it would have no relation to the cargo. The ingots could have been there throughout the life of the vessel.

If the iron was picked up in China this highlights an interesting and unexpected trend in the raw metals trade. In Immanuel Wallerstein's world systems model, regions in the core commonly exploit regions in the periphery for their raw materials, while trading manufactured goods with peripheral areas.[319] China has usually been regarded as the core of this type of interaction, with Southeast Asia as the periphery. If the iron ingots are from China, it shows a reversal of this process. Boats like the Santa Cruz and the Lena Shoal are Southeast Asian styled junks (as discussed in Chapter 1), which are increasingly trading raw materials with Southeast Asian communities. This shows an increasing metal manufacturing industry and metalwork specialisation roles throughout the region.

3.4.2.2 White Metals

"White metals" connote any metal with a high percentage of tin or lead. Materials in this category have the unique quality to passively deal with the act of corrosion in any environment, terrestrial or submarine. Unlike the more anodic metals (e.g. iron and zinc) that are continually beset upon corrosive agents, white metals when oxidising develop a thin invisible oxide layer which acts as a barrier between the metal and its caustic environment.[320]

In an aqueous medium, this oxide layer gets attacked (usually) by chloride ions and over time develops a thick layer of concretions made up of marine seabed organisms and calcareous deposits from shells. This layer acts as an oxygen barrier, which hinders the access of electrolytic solutions to the metal.[321] Even though the material has a higher chance of preservation, the surfaces of white metals are usually greatly pitted due to corrosion from the chloride ions.

Tin Ingots

[319] Wallerstein 1989; Wallerstein 2004; Wallerstein 2011
[320] Memet ,J.B 2007, p.25
[321] Which could be a benefit and a drawback. From an excavation perspective, the oxide barrier can aid in the preservation of the material. From a conservation perspective, there is an added difficulty in preparing the correct electrolytic solution to penetrate the oxide barrier to properly conserve the artefact.

Tin ingots were found on the Bakau,[322] Lena Shoal,[323] and the Santa Cruz [324] wrecks. Two ingots were recovered from the Bakau, while the Lena and the Santa Cruz yielded over a hundred ingots each.[325] They are all in the shape of a truncated pyramid. Each truncated pyramid has a spacer in its rear of the ingot to pair two together, thereby making a double ingot (Fig. 3.41). The tin ingots on the Bakau were not mentioned in Flecker's article.[326] I was only made aware of the ingots on the Bakau through the accession inventory of the National Experiential Museum.

Some of the ingots in the Lena Shoal and Santa Cruz assemblages were embossed with an image, likened to a mangosteen rosette (Figs. 3.42, 3.43). These artefacts were most likely obtained as a raw material to manufacture other objects.[327]

[322] Liow 2013
[323] Goddio et al. 2002, p.248
[324] Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996
[325] See appendix 2.
[326] 2001b
[327] Goddio et al. 2002, p.248

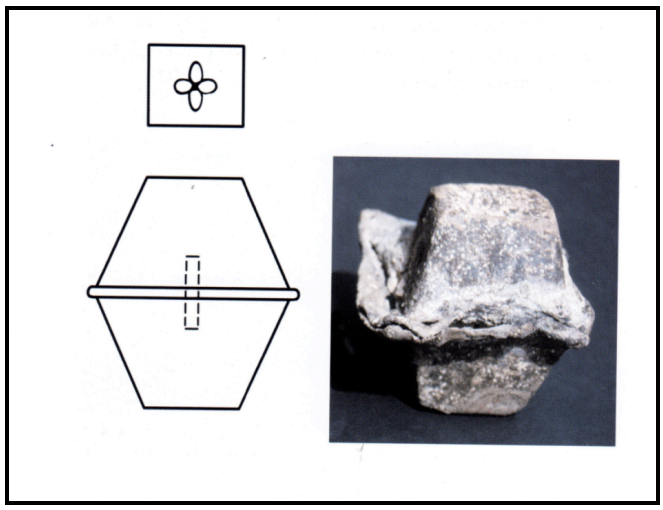


Figure 3. 41: Tin ingot from the Lena Shoal (Note: (patterned) embossed rosette in top left corner). (Goddio, et al, 2002, pg. 248)



Figure 3. 42: Tin Ingot with embossed rosette. (Brian Fahy)



Figure 3. 43: Modern usage of mangosteen rosette. (www.siam-celedon.com)

As much as two thirds of the world's tin deposits can be found in Southeast Asia along the Western Tin Belt Region; from sporadic deposits in Yunnan, down to the Isthmus of Kra and the Malay Peninsula, to Banka and Beilitung in the South. While Banka and Beilitung have more tin reserves per square meter than the rest of the Western Tin Belt, these areas were not a large producer of tin until the 18th Century.[328] Kedah and Sangalor on the west coast of the Malay Peninsula and Patani on the east coast were regions renowned for their tin since the 10th Century. A number of stone moulds for casting tin ingots were unearthed in Malaysia,

[328] Flecker 2002a; Somers Heidhues 1992, p.123

and bi-faced moulds for truncated pyramidal ingots with wide base flanges were found in Malacca.[329]

Historical accounts state that in Malaysia, specifically the state of Perak, tin intended for commerce was cast into ingots of fixed weights and used for all transactions in the bazaar.[330] These tin ingots circulated exclusively in Perak, Selangor and Negeri Sembilian starting from the 14th Century (Fig. 3.44).



Figure 3. 44: States of Malaysia that were using tin currencies starting from the 14th Century. (Brian Fahy)

[329] See Flecker 2002a, p.67.
[330] Singh 1996, p.183



Figure 3. 45: Early Conical Tin Currencies of Malaysia. (Singh, 1996, pg. 183)

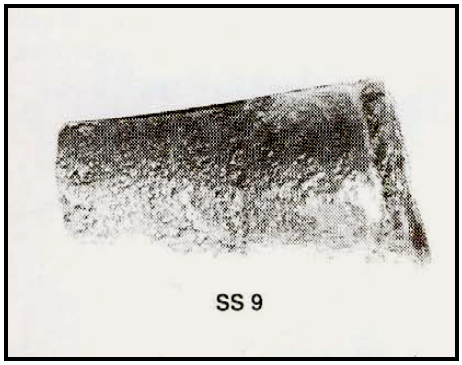
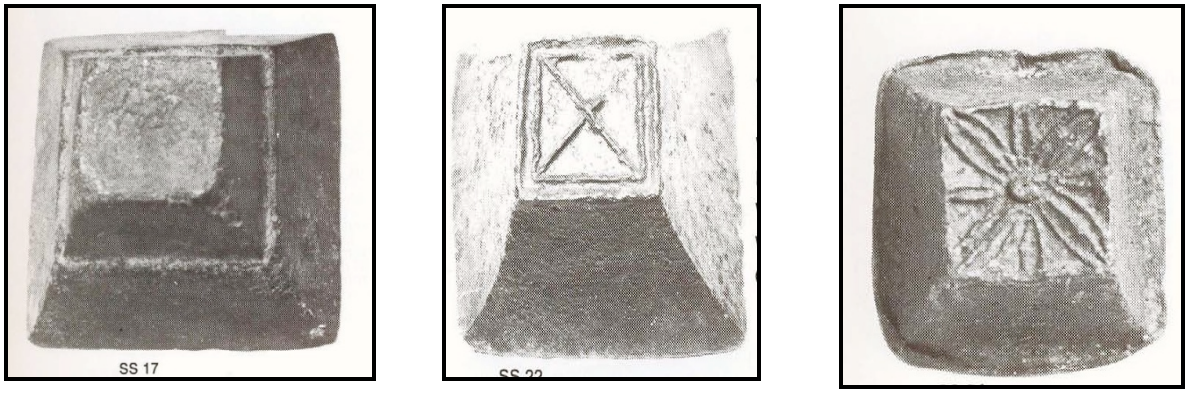


Figure 3. 46: Early Conical Tin Currency of Malaysia. (Singh, 1996, pg. 183)

Typologically it can be seen that the earliest ingots were simple sand moulds cast in the cylindrical and conical shapes. (Figs. 3.45, 3.46) These ingots gradually developed into a sawn off four sided pyramid, known as a "sugar loaf type" (Figs. 3.47, 3.48, 3.49). [331]

The ingots on the Bakau, Lena Shoal and the Santa Cruz are similar in shape to the later tin currencies of Malaysia, yet they are larger. This increases the likelihood that they were used as a raw material rather than a currency for trading. Only two tin ingots were found on the Bakau. This could possibly represent a sample of new material for traders to consider investing in, or that the rest of the tin was off loaded at some earlier stop. The larger quantities of this material found on the Lena Shoal and the Santa Cruz clearly suggests that there was a market for this raw material.

[331] Ibid.



Figures 3. 47, 3. 48, 3. 49: The evolution of tin currencies in Malaysia. Note the patterned rosette on the far right image. (Singh, 1996, pg. 184)

Case study: embossed tin ingots

During the initial examination it was noted that some of the ingots were decorated. As the meaning of the rosette is somewhat opaque, it is possible that it represents a specific production area. A programme of elemental analysis was undertaken to ascertain any qualitative difference between the embossed (Fig. 3.42) and non-embossed tin ingots (Fig. 3.50) from the Lena Shoal and the Santa Cruz. Goddio mentioned that "some" of the tin ingots from the Lena were embossed, but gave no exact number.[332] To determine any elemental difference between the embossed and non-embossed ingots, the use of a hand-held Energy Dispersive X-Ray Fluorescence Spectrometer was employed. A Bruker TRACeR III-V Handheld XRF was used to collect spectrographic samples from the tin ingots of the Santa Cruz and the Lena Shoal. It was planned to sample ten per cent of the tin ingot assemblage. The TRACeR III-V would measure samples from between 10.89 seconds to 25.39 seconds.[333]

[332] Goddio et al. 2002, p.248

[333] A spectrographic reading could be obtained from the XRF after a few seconds, but the longer the beam is on the sample, the more defined the elemental spectra is. The reason for the longer beam times (over 15 seconds) was due to problems on finding a part of the sample that the handheld XRF could read. The trigger was depressed on the unit and moved around the sample to find an area that could be detected by the machine.



Figure 3. 50: Non-embossed tin ingot from the Lena Shoal. (Brian Fahy)

The goal was to see if the embossed and non-embossed ingots came from different sources of tin. Since no spectrographic analysis has been done on any tin sources, it would be a matter of comparing spectra of the two sample sizes to see any similarities or differences. While the theory of this question is sound, the application turned out to be quite problematic.

Firstly, upon visiting the National Museum in Manila to look at the tin samples, the corrosion on most of them are so extensive that it was extremely difficult to identify the ingots that were embossed. Of the 169 ingots I documented from the Lena Shoal, only two embossed ingots could be distinguished. The tin assemblage of the Santa Cruz was similar. Only two of the nearly 100 ingots could be identified as having an embossment on them due to their condition.

A second problem arose when I was attempting to take spectrographic samples of the ingots. I found that multiple spectra taken from one sample would yield differing elemental spectra. The tin peaks on the spectra would fluctuate depending upon the thickness of the calcified layer of corrosion on the samples. The hope was to use the handheld XRF since it is a non-destructive method in obtaining elemental data. The use of a more powerful XRF might have yielded a more uniform spectrum (since the beam is more powerful) but it would also be necessary to cut into the ingots to reach an area of tin that was less affected by corrosion.

The initial concern would be to identify the embossed and non-embossed ingots.[334] It is possible that with a more intensive conservation regimen the ingots could be identified as

[334] If there are not enough embossed ingots in the sample size then the study could stop there without more artefact destruction.

embossed and non-embossed and it could then yield the appropriate data set. However, it is also possible that a more destructive approach is needed to obtain the necessary data.

If the data revealed that the two types of ingot were from different sources, at the very least it would highlight the need source tin throughout the region in order to possibly identify where the ingots are coming from. The volume of tin on these vessels certainly shows that metals are traded just as widely as ceramics, yet so little is known about metals.

Lead Bidor

Lead ingots were found on the Ko Si Chang III[335] and identified on the Santa Cruz.[336] Over 2000 lead ingots were found on the Ko Si Chang III and appear like "hat shaped" circles (Fig. 3.51). During my fieldwork, only twenty-one were located at the Underwater Archaeology Museum in Chanthaburi. Most of the lead ingot assemblage was spread between several local museums, the Underwater Archaeology Museum and the National Museum in Bangkok.

At the National Museum in Manila, there were no lead ingots to document from the Santa Cruz. It is of this author's opinion that all of the ingots that were identified as lead in the assemblage inventory were in fact tin. The inventory claims to have recorded 65 lead ingots, some labelled "pyramid" shaped. There is no published material on "pyramid" shaped lead ingots, yet there is a temporal continuity in the hat shaped circular lead ingot. These types of lead ingots were excavated from a 19th Century boat in Samed Ngam.[337]

Little study has been conducted regarding the sourcing or usage patterns of lead ingots in the region. Prehistoric sources of metal have been identified (Fig. 3.52), but no historical data is available.[338] Thailand's' lead trade has a long history. Written accounts of the 12th and 13th Centuries declare that lead was a commodity traded from Thai entrepots by Chinese sailors.[339] Suffice it to say that with the possible mislabelled material from the Santa Cruz, lead only shows up on one wreck in this case study. It is the one ship that is hypothesized to be local coastal trader. Without the material assemblage from the Santa Cruz this shrinks the traded footprint of lead ingots back to the territories of peninsular Southeast Asia.

[335] Green & Harper 1983
[336] Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996
[337] Intakosai 1983
[338] Higham 1989, p.191
[339] Hirth & Rockhill 1911



Figure 3. 51: Lead ingot from the Ko Si Chang III. (Brian Fahy)

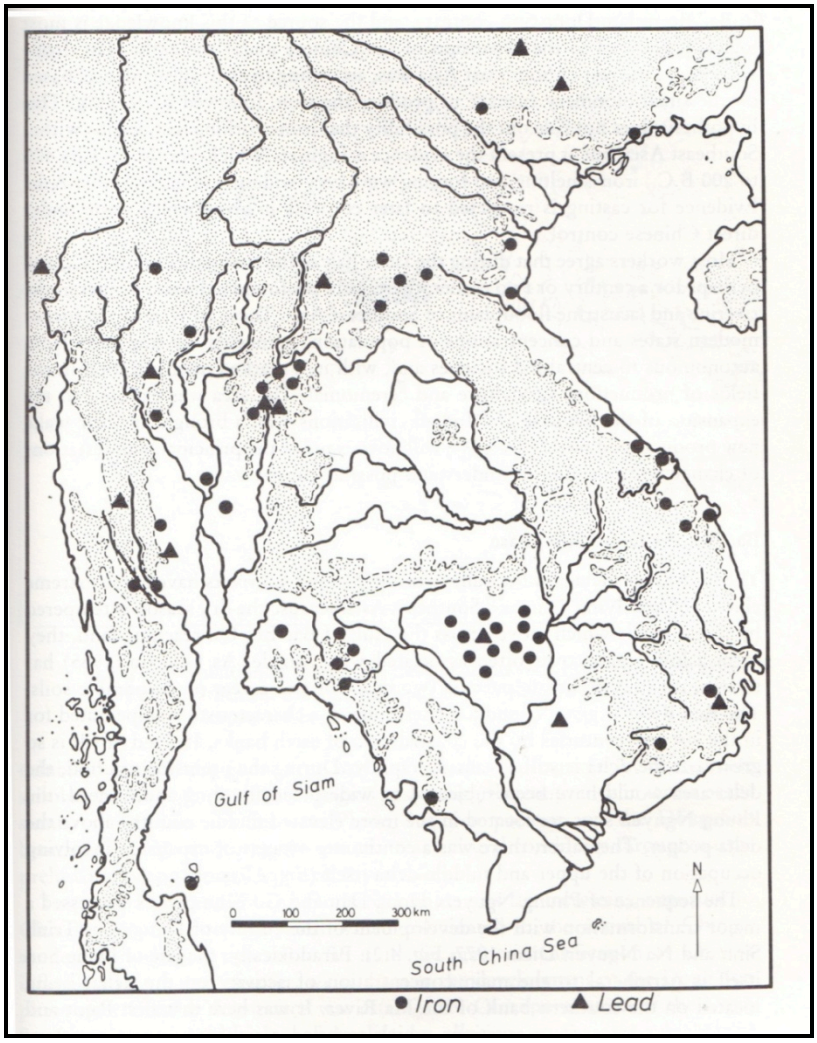


Figure 3. 52: Iron and lead sources in mainland Southeast Asia. (Higham: 1989)

Copper Ingots

Copper ingots were found on the wrecks of the Rang Kwien[340] (Fig. 3.53, 3.54) and the Ko Si Chang III.[341] They are plano-convex shaped on the Rang Kwien and 'bun' shaped on the Ko Si Chang. The two different casting forms could indicate that they come from different copper mining regions. There is a plethora of copper sources in peninsular Southeast Asia (Fig. 3.22). When we pair the peninsular sources of copper with the peninsular sources of lead, they tend to occupy similar geographical areas. Both types of resources are abundant in the Mekong and Chao Praya deltas. Both wrecks occurred in the Eastern Gulf of Thailand, which could point to a local metals trade between post-Angkor communities and the Ayutthaya region.



Figure 3. 53: Copper ingots from the Rang Kwien. (UAD, Thailand)



Figure 3. 54: Copper Ingot from the Rang Kwien. (Brian Fahy)

Copper Sheeting

Copper sheeting was recorded in the excavation inventory of the Santa Cruz. During my fieldwork visiting the National Museum in Manila, no copper sheeting could be found, and therefore it was not documented. It was possible that the copper sheeting was similar to the materials used to fabricate the copper repoussé wares from the Lena Shoal. Most likely this material was donated to the HILTI Foundation.

3.4.3 Unassigned material

Lime pots

[340] Intakosai 1983; Intakosai 1984
[341] Green & Harper 1983

A series of bronze lime pots were discovered, on the Ko Si Chang III[342] (Figs. 3.55, 3.56) and Rang Kwien wrecks.[343] Betel nut chewing has a long tradition in Thai culture, although it has only recently been studied.[344] The lime pots resemble ceramic versions created in the Si Satchanalai kilns in Thailand. Only three were found on the Ko Si Chang III, which could make it either something very rare and prized, or a common tradition among sailors. The fact that it was found only on the Rang Kwien and the Ko Si Chang III again could point to a smaller local trading network, or point to local travellers' or sailors' possessions.[345] Areca nuts were found on these two wrecks as well as the Lena Shoal, which could highlight a connection to the organic material found within these assemblages.[346] The pots carry slaked lime inside them. A few slices of areca nut were wrapped in an areca leaf along with the lime from the lime pots. It acted as a stimulant. The lime cuts the cheek and gums open, allowing the stimulating effects of the areca nut to enter into the bloodstream faster.

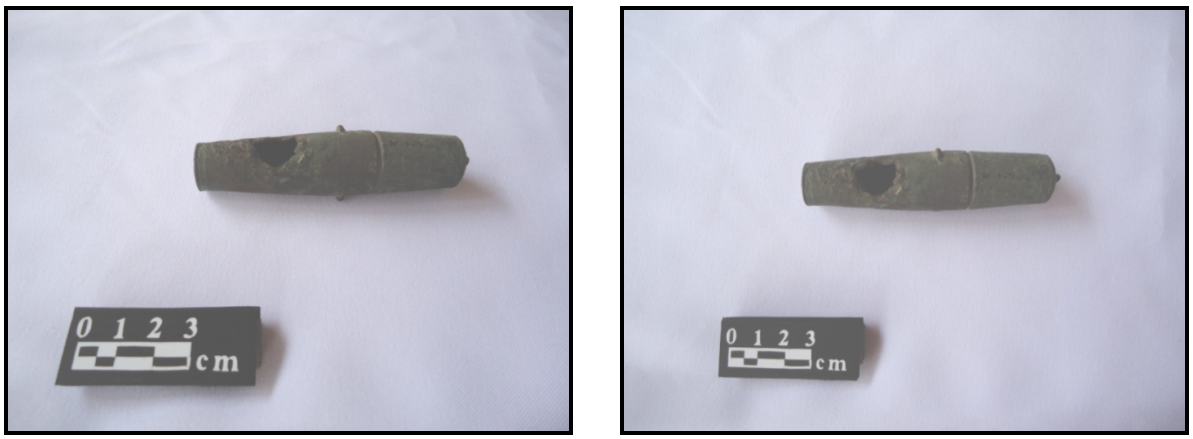


Figure 3.55, 3.56: Lime pots from the Ko Si Chang III. (Brian Fahy)

Pewter Items

Two pewter ewers and one pewter kendi were recovered from the Bakau wreck. They are in an Islamic style, with a gourd-like body, a long handle and long spout, with a support attaching the top of the spout to the upper part of the body. They are both in very poor condition, but an example of the style can be seen in Fig. 3.57. Ceramic and metalwork versions exist between many vessel forms, but metal versions of these ewers are uncommon

[342] Green & Harper 1983
[343] Intakosai 1983
[344] Rooney 1996
[345] Bronze limepots were also found on the Ko Si Chang I, Ko Si Chang II and the Ko Samui. All three wrecks located in the Gulf of Thailand. See Intakosai, 1983.
[346] See Chapter 4 regarding Areca nuts.

in Southeast Asia. The shape is not found in ceramic form aboard the Bakau, which adds to its unique quality in the assemblage. It is unknown where the items were found which would assist in ascertaining whether this cargo may have been for personal use or a trade good.

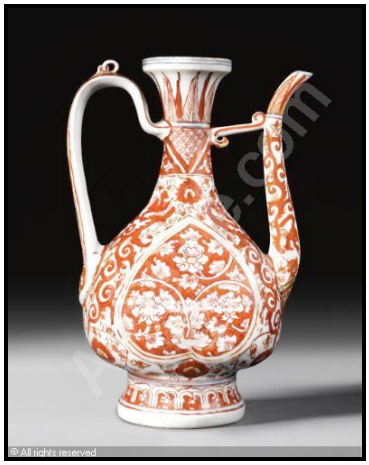


Figure 3. 57: Islamic style ewer. (www.artvalue.com)

The pewter kendi has a similar shape to the ceramic kendis found on the Bakau, the Ko Si Chang III, the Lena Shoal and the Santa Cruz. The kendi form was in use throughout Southeast Asia since the 10th Century.[347] Two hundred and seventy one kendis were recovered from the Bakau, of which only one was metal.[348] The popularity of such an item is too widespread to hypothesize about their intended market, but the uniqueness of this type of metal object suggests that it is quite special. It is unknown whether the kendi was found within, or apart from the cargo. Therefore a determination could not be made on whether this item was for personal use, or laden cargo. If it was not found with the trade goods, then as an isolated item made of a non-breakable material, it would have been an ideal shipboard item. The material is relatively heavy and so is good to use on a pitching vessel.

Jewellery

Two gold bangles and one gold and gemstone ring were recovered from the Rang Kwien (Figs. 3.6, 3.7).[349] These are the only precious metal items found on the ships in this case study. These items, along with the four hundred kilograms of coinage found within the assemblage, again highlight the wealth contained on this ship. It is unknown whether this was personal property or material commissioned for a patron. The recovery of a tiny brass hammer may signify a type of jeweller or gem specialist on the boat (Fig. 3.58). These items

[347] Fisher 1993, p.103
[348] See Appendices 1 and 2.
[349] Intakosai 1983 See also Appendix 2.

may have been selected samples to promote commissions and ply their trade in a new destination.



Figure 3. 58: Copper alloy hammer found on the Rang Kwien. (Brian Fahy)

3.5 Discussion

3.5.1 Ship Assemblage Narratives

By incorporating the analysis of the metallurgical material with the ceramic shipwreck narratives from Chapter 2, we can begin to see a more nuanced pattern of trade.

The Turiang is a Chinese-style boat that contained ceramics from China, Thailand and Vietnam (Fig. 2.56). Thai wares made up the bulk of the ceramic assemblage; nearly one-and-one-half times (57 %) that of the Chinese ceramic material (35 %). Vietnamese wares made up the difference (8 %). Iron in powder form was present, likely from the iron sand beaches of Sumatra or Java (Fig. 3.59).

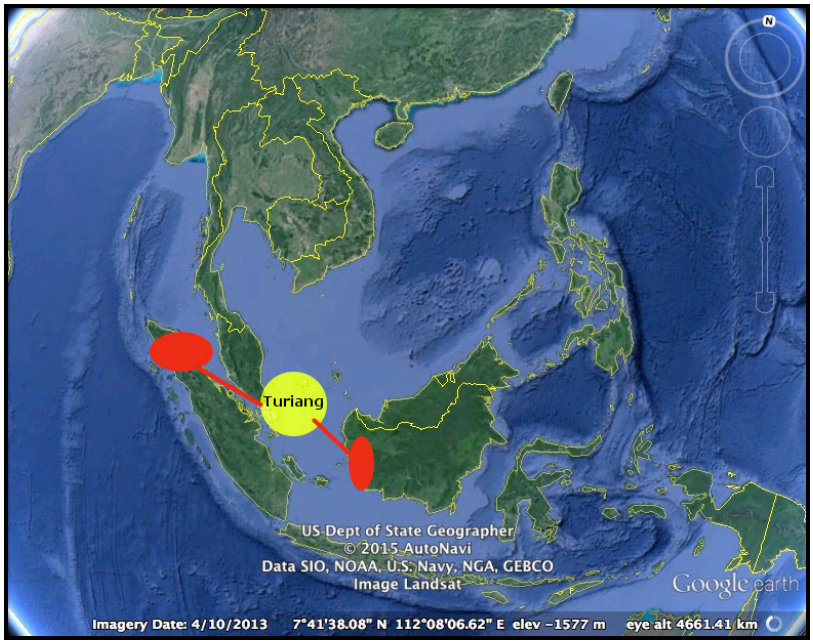


Figure 3. 59: Network of metal material from the Turiang. (Google Earth, additions by B.Fahy)

The Bakau is a Chinese-styled boat that contained ceramics from China, Thailand and Vietnam (Fig. 5.57) Thai wares make up the bulk of the ceramic assemblage (67 %), over double that of the Chinese ceramic material (32 %). Vietnamese wares make up the lowest proportion (1 %). Tin ingots from Malaysia were present in the assemblage, as well as bronze mirrors and tweezers, gongs, cannons and coins from China (Fig. 3.60). Iron pots found on board were also manufactured in China. The ship also provides evidence of other metal items like fishhooks, scale chains and weights, and fish, net, and sounding weights which, while they cannot be attributed to any specific region, give clues into life on board ship.

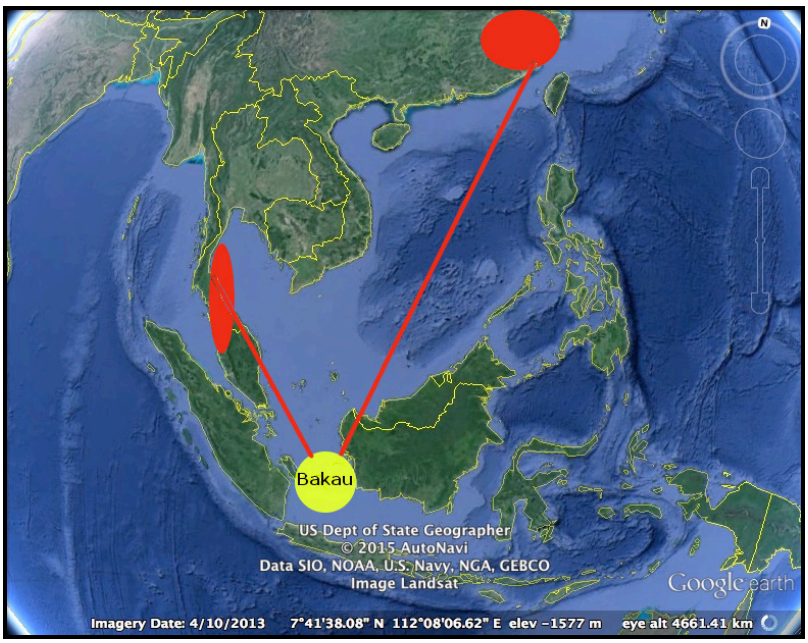


Figure 3. 60: Network of metal material from the Bakau. (Google Earth, additions by B. Fahy)

The Rang Kwien is either a Japanese or Chinese styled junk that contained ceramics from China, Thailand and Vietnam (Fig. 2.58). Thai wares make up the bulk of the ceramic assemblage (75 %) with over four times as much material than Vietnamese wares (18 %). Chinese ceramics make up the lowest identified portion (3 %). Lead and copper ingots were also part of the assemblage, raw materials likely sourced from Thailand. Chinese items include thousands of minted coins, iron pots, a bronze mirror and a bronze gong (Fig. 3.61). A tsuba from Japan was also recovered. Finery was found on board in the form of jewelled earrings, revealing some of the wealth that travelled through the region.

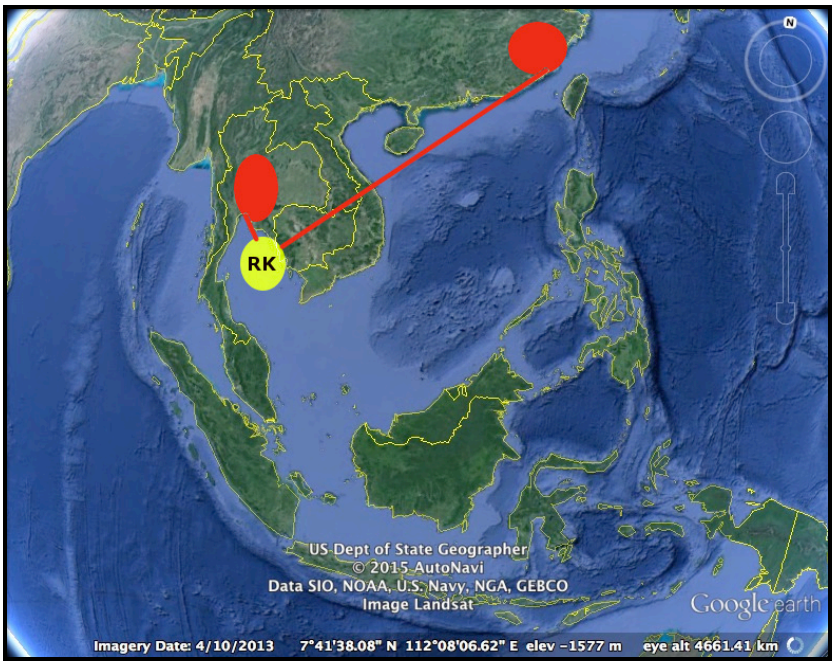


Figure 3. 61: Network of metal material from the Rang Kwien (Google Earth, additions by B.Fahy)

The Ko Si Chang III is a Southeast Asian-styled junk that contained ceramics from China, Thailand and Vietnam (Fig. 2.59). Thai wares make up most of the ceramic assemblage (95 %). Very few Chinese (1 %) and Vietnamese (1 %) ceramics are part of the assemblage. Lead and copper ingots were part of the assemblage, likely mined in Thailand. Bronze lime containers likely manufactured in peninsular Southeast Asia was found on board as well (Fig. 3.62).

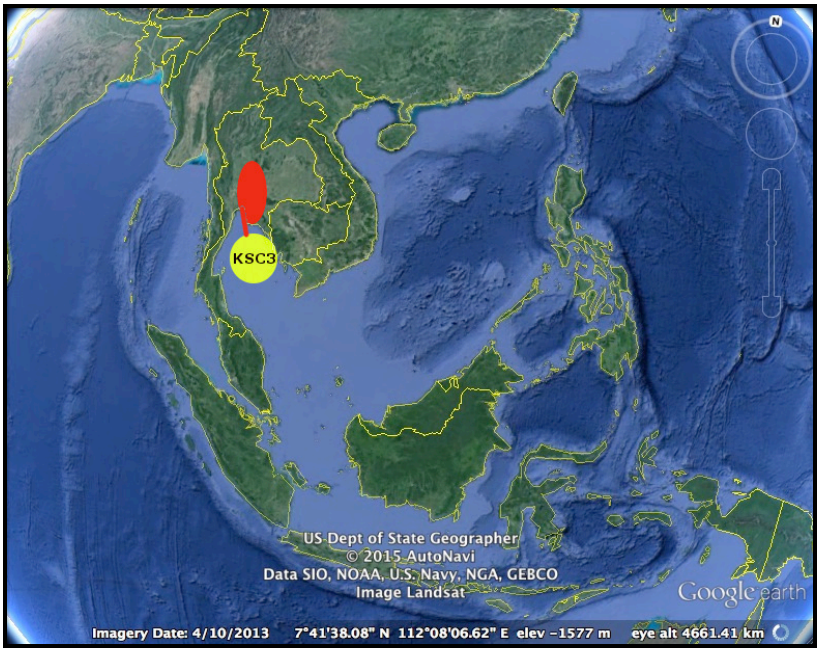


Figure 3. 62: Network of metal material from the Ko Si Chang III. (Google Earth, additions by B.Fahy)

The Lena Shoal is a Southeast Asian-styled junk that contained ceramics from China, Thailand, Vietnam, and Burma (Fig. 5.60). Chinese wares make up the bulk of the ceramic assemblage (71 %), its proportional makeup is over three times larger than its next largest ceramic type (Thai, 23 %). Burmese wares (3 %) and Vietnamese wares (1 %) round out the proportional representation. Tin ingots from Malaysia were part of the assemblage. A large amount of brass bracelets, likely manufactured in Peninsular Southeast Asia, was also present. Chinese material included bronze cannons, gongs and coins, as well as iron pots and needles (Fig. 3.63).

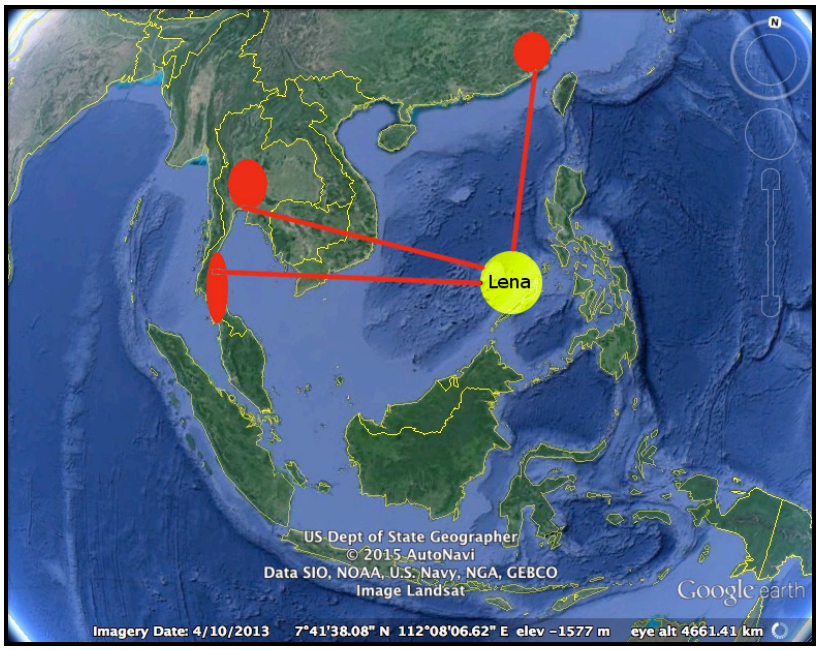


Figure 3. 63: Network of metal material from the Lena Shoal. (Google Earth, additions by B.Fahy)

The Santa Cruz is a Southeast Asian-styled junk that contained ceramics from China, Thailand, Vietnam and Burma (Fig. 2.61). Chinese wares make up the bulk of the ceramic assemblage (86 %), with Thai (9 %), Burmese (3 %), and Vietnamese (1 %) rounding out the rest of the representational proportion. Tin ingots from Malaysia were part of the assemblage. A large amount of brass bracelets, likely manufactured in Peninsular Southeast Asia, was also present. Chinese material included bronze cannons and gongs, as well as iron pots (Fig. 3.64).

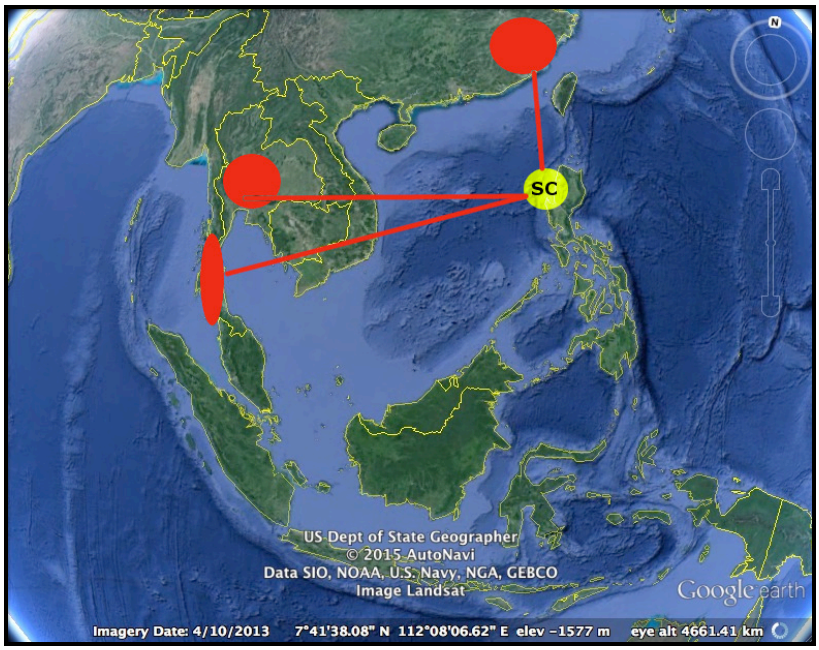


Figure 3. 64: Network of metal material from the Santa Cruz. (Google Earth)

3.5.2 The increasing trade in metals from the 14th and 15th Centuries

The ships in this study yielded a wide variety of metallurgical artefacts. Beginning with the wreck of the Turiang *c.*1370 CE ending with the wrecks of the Lena Shoal and Santa Cruz *c.*1490 CE, there seems to be an increasing trend in the trade of raw metals and manufactured metal trade goods. The Turiang was the only boat that carried iron granules. The Bakau was laden with a few tin ingots and a large amount of iron pots; as well as a multitude of bronze gongs, mirrors and tweezers. While there was no metallurgical raw material on the Rang Kwien, there was a large amount of Chinese coinage and copper ingots. Lead and copper ingots were located in the cargo hold of the Ko Si Chang III. The Lena Shoal and the Santa Cruz both carried large quantities tin ingots and pig iron, as well as a trading complement of iron pots and brass bangles. The Lena Shoal had an additional repertoire of copper repoussé

wares and a few iron needles while the Santa Cruz had a few pieces of copper sheeting. Metals, whether as raw materials or finished trade goods, were clearly a complementary part of the cargoes of trading vessels in fifteenth century Southeast Asia.

Various manufactured metal items that could not be identified as trade goods were also catalogued throughout the six shipwreck assemblages. Chinese coins, bronze gongs and cannons were present on every ship except the Ko Si Chang III. The Bakau assemblage consisted of one bell, one spearhead, net and sounding weights as well as fishhooks and pewter vessels; Not only did the Rang Kwien carry hundreds of kilos of Chinese coins, it had limepots, jewellery and fishhooks. A bronze phallus was part of the Ko Si Chang III assemblage, and the Santa Cruz carried net weights, one lamp and one crown. Consequently, it is also clear that sailors and travellers would also have a range of metallic objects at their disposal during their lives at sea and in port.

Referring to Tables 3.3 and 3.4, we see a widespread increase in the trade of metallurgical raw materials. The iron granules carried by the Turiang were not duplicated in any other assemblage in this study. The copper ingots on the Rang Kwien and the Ko Si Chang III show an increased trade in the material but little could be ascertained as to its intended market. As mentioned previously, the Ko Si Chang III is the smallest boat in the study. In terms of ship size and metal artefact assemblage, the Ko SI Chang III was most likely a local trading vessel. It could suggest a regional popularity for the material on the boat, or a boat bound for a larger emporia.

The tin ingots from the Bakau, the Lena Shoal and the Santa Cruz clearly show the increased trading practice for this material. The few ingots found on the Bakau could reflect a sample of a new product while the nearly one hundred ingots found on each of the Lena Shoal and the Santa Cruz wrecks represent stark increase in the trade of this product. The presence of pig iron on these two ships also signifies an increased trade in this material as well. The trade in iron pots were consistently present from the Bakau wreck onward, save the smaller, local ship of the Ko Si Chang III.

3.5.3 The contents of the excavations

This study of metals highlights some of the problems researchers encounter in modern maritime archaeology. As it was stated in the beginning of the chapter, to understand this material is to first understand the environment in which it is found. Most of the metals

undergo a physical transformation in seawater to some degree; it ranges from mild tarnish to complete disintegration. Even in perfect conditions, archaeologists cannot assume to recover all of the material. In a seawater environment, many metals are destroyed. Due to this natural transformation, corrosion of metals will result in the removal of some objects from the archaeological record.

However we also need to understand the academic, economic and corporate environments and the motivations that surround these wrecks as well. Not all wrecks are excavated in the same manner, and the collection, selection and retention strategies will result in different kinds of shipwreck assemblage. Without being able to properly observe and document each excavation from beginning to end, we can only question the motivations behind each excavator pertaining to what material may have been purposefully overlooked or recovered. We have five shipwrecks excavated by different entities.[350] Material that was possibly left in situ on the Bakau wreck might have been due to aesthetic reasons or monetary ones. A purely academic entity may have handled the excavation and material differently. For example, the excavations of the Santa Cruz and Lena Shoal, which recovered large quantities of metal objects, would have been different if managed by treasure hunting firm Seabed Explorations. The point here is that underwater archaeologists may use similar methods of extraction and conservation to bring an assemblage to the surface, but because of the different motivations and ambitions of the excavator involved on each wreck, we can only compare the assemblages with each wreck with a small degree of certainty and for commodities such as pottery, which were excavated by all, rather than for metals, which were excavated only by a few projects.

At the very least, this chapter highlights a largely overlooked medium in maritime trade. As these artefacts come out of the water, they are marginalized. Metallurgical artefacts from shipwrecks are considered as trivialities; seen as inconveniences, rather than part of the narrative. The truth is that treasure hunters, archaeologists and conservators are correct. Metal artefacts are very inconvenient. The costs to conserve, restore and analyse metals are prohibitive, especially when compared to ceramics. During my fieldwork, I noticed that the condition of many of these artefacts was waning in the departments that have a limited budget for conservation. The National Museum in Manila and the Underwater Archaeology Museum in Thailand need to prioritize their conservation practice, because they cannot afford

[350] As noted in Chapter 1, the *Lena Shoal* and the *Santa Cruz* were excavated by the same entity: Franck Goddio of the HILTI Foundation in conjunction with the National Museum of Manila.

to conserve everything they accession. So a form of "conservational triage" is established. The goal of this triage is to maximize survivability while consistently staying within a limited budget. In this, many artefacts are saved, yet some artefacts suffer. Projects under ideal circumstances, with a large budget, and access to vast resources, like the Mary Rose, are able to promote good conservation ethics.[351] The conservation stabilizes the artefact and does not allow it to degrade further, which is the very least that should happen with all artefactual material. This follows on from on-site first aid work.

The Experiential Museum in Singapore is different. Being a private museum, they have access to funds that the state run museums do not have. The Experiential Museum is owned by Resorts World Sentosa, and their profits from the hotels and casino fund a very competitive and modern museum. There are modern facilities specifically built and allocated for the preservation of all metallurgical material, along with large warehouses for future planned accessions. The staff-to-artefact ratio is very high; therefore the objects are under closer observation and protection. The material from the Bakau represented the best-conserved metallurgical material in this case study, because the Experiential Museum has the money to invest heavily in the conservation of this material. Also, since they invested in this material, they want to keep it in good condition.

Again, that is not to say that policies are not in place in the other locations of the case study. Departments do the best they can by deciding what material will garner higher user (visitor) interest than those that are less likely to do so. Preferential treatment is then given to metalworked items rather than the raw materials found in these assemblages. This is why we see one to two per cent of ingots encased on display in a museum, and the other 98 per cent deteriorating in a plastic bin. The belief is there is little need to conserve all of these items. For all intents and purposes they are all the same thing, and no one needs to see one hundred of the same object. This is grist to the mill for the treasure hunters who argue that simply because we have hundreds of identical items, some can be sold off to pay for the research and conservation of the rest. This is the position that companies like Odyssey Marine takes on coins, for example.[352] This position represents however, further deterioration of a decreasing resource hence we are experiencing the removal of more metal from the archaeological record.

[351] Gardiner & Allen 2005
[352] OME 2015

I would argue that for this reason, analytical research should be conducted on the metallurgical items before any other type of artefact. If the unfortunate practice is to passively abandon much of this material to corrosion, we should prioritize the research to focus on the metallurgical material first, and then proceed with analysing the material that has a longer conservation shelf life. If the material has been scientifically catalogued, interpretations can be made from the data at any later time. The corrosion cannot be reversed. Scientific research conducted on oxidized or corroded metals would yield different data and would necessitate the need to destroy the material in order to analyse it. I would go so far as to say that leaving these items in situ in some cases might be better than leaving object to fall apart through neglect. In a way, treasure hunters accidentally prescribe a better conservation method in that metal artefacts preserved in situ and not removed from their burial environment have a much better chance of being preserved into the future than excavated materials that are neglected and not conserved or critically monitored in safe storage.

3.5.4 Adding new information/developing interpretations

The chapter also brings to light how little we know about metallurgical trade patterns. The copper vessels, the ingots and the lead bidor are materials about which there has been little scholarship and thus there are gaps in understanding their presences (or absences) in regional trade networks. As we begin to look at this material over longer and longer spans of time, it is increasingly necessary to understand the origins of the material. The research conducted here suggests that tin has a larger trading footprint than lead. The lead bidor are only found in wrecks located within the Gulf of Thailand and traded on smaller ships. The presence of the tin ingots on the Lena Shoal and the Santa Cruz point to trading patterns in the Philippines and the Indonesian Archipelago.

Southeast Asia is often neglected when we discuss world systems theory or larger concepts of trade within the Indian Ocean and the China seas. Traditional studies of the region assume that it manufactures little but has a huge raw materials trade. Economically, Southeast Asian resources are talked about in terms of always going away from greater "Southeast Asia".[353] Yet when we look at this sample set from a wider perspective, patterns begin to emerge. These show an increase in the scale of the trade in metals trade from the Early Ming to the Middle Ming period. It shows that the trade in raw materials during this time began to spread throughout Southeast Asia instead of simply showing a path to and from China. We have

[353] Frank 1998, pp.92–96; Abu-Lughod 1991, p.282

known that from a ceramic perspective, the maritime trade system in the region was a complex one. It can be said with some certainty that the metals trade corroborates this complex network. This evidence shows not only that other material is coming from outside of these ceramic centres (e.g. tin ingots from Malaysia, iron sand from Indonesia), but also that some ceramic centres were clearly trading in products other than ceramics (lead and copper ingots from Thailand, iron pots and coins from China).

There is also a missed opportunity for archaeologists to interpret meaning and intention with some of these artefacts. In some of the archaeological reports there is a sense of flippancy when identifying non-ceramic artefacts. While the mere mention of them is certainly necessary, and understandable in the early years of underwater archaeology, yet the level of interpretation has deepened with the maturity of the field and we should now demand more subtlety from our interpretation of metal objects. For example, George Bass' analysis of toiletries from the Serçe Limani yielded interesting interpretations on its' crew, its' passengers and daily life aboard the eleventh century vessel.[354] Similar interpretations could and should be forwarded for the material preserved on Southeast Asian ships. The potential is surely there, and the analytical methods for interpreting this material are well established.

The bronze mirrors and tweezers, while interesting artefacts in their own right, give us insight into the meaning of objects. Both of these items were common toiletries in wealthy Chinese grooming kits.[355] The presence of these as items as a trade good in the region could suggest a cultural transfer about concepts of beauty. It could mean that there is a rising popularity in Far Eastern beautification techniques outside China, or they are simply items for wealthy Chinese nationals who live overseas.

To help redress the balance between ceramic and non-ceramic artefacts, we must make large inroads into understanding the raw material trade in the South China Sea in the fourteenth and fifteenth centuries. More analysis in the sourcing of metallurgical material and comparing them to terrestrial archaeological sites is required to recognize the potential contribution that the medium has to offer Southeast Asian underwater archaeology. Unfortunately the archaeology and history are not there to explain these roles in Southeast Asian trade networks.

[354] Bass et al. 2004
[355] Ho 2005, pp.90–97

4.0 Organic Material

4.1 Introduction

The goal of this chapter is to identify the various organic artefacts found on the shipwrecks in this case study in order to add further detail to the narrative of each of the ships. The organic material discussed in this chapter is defined as "material relating to, or derived from living matter". It should be noted that the organic material covered only pertains to the artefactual material from the assemblage and not the wooden material associated with the hull of the wrecked ship.

Little research has been conducted on the interpretive analysis of organics on shipwrecks found in Southeast Asian waters.[356] A deeper interpretive analysis of these items could lead to a greater understanding of the trade in organic materials and aspects of shipboard life where some of these items were normally consumed. I will first list the materials found from each shipwreck excavation, and then go into each type of artefact in depth.

4.1.1 Degradation of organic materials in an underwater environment

Like metals, organic materials suffer a similar fate when found in seawater, where it normally undergoes rapid decay and is usually destroyed. Yet, in some instances there is an increased chance of preservation. If this material manages to remain contained on the site of a wreck, either by staying in its original packaging or if the material gets silted over quickly, the speed at which organic material degrades slows greatly. The reason for these unique states of preservation is mostly due to the amount of oxygen interacting with the material.

The basest premise of organic decay is that the level of oxygen in a body of water directly determines the level of living microbes in the same area (e.g. a higher the level of oxygen produces a higher amount of microbes and vice-versa). These microbes assist in breaking down the organic material present in their environment, whether they are in the earth or under water.[357] This is the basic principle of aerobic composting.[358] The biodegradation caused by marine fungi occurs at the sediment-water interface, the sea floor, while bacterial degradation can occur both in seawater and in sediment up to approximately 60 cm in depth, which is the

[356] Flecker 2001a; Krahl et al. 2010; Goddio et al. 2002
[357] Greenwood 1961; Hulthe et al. 1998
[358] Himanen & Hänninen 2011

maximum depth for bacterial activity.[359] Mitigating factors like temperature, humidity, depth and sediment interface also affect the speed at which the material decays. [360]

The lack of oxygen in any environment aids in the preservation of this material. Even on terrestrial excavations we see organics preserved to varying degrees in anaerobic conditions. Preservation can range from a complete degradation of organics, to environments where whole bodies are preserved, including skin, hair and stomach contents.[361] As we will see in this chapter, much like the metals, organic material occasionally manages to survive the marine environment and consequently should be available to be excavated and form part of the shipwreck excavation reports and archives.

4.2 Organic inventories of the case study assemblages

The inventories listed below are also detailed in Appendix 3: Organic Material Distribution.

4.2.1 Early Ming Wrecks

Turiang (1370-1400CE)[362]

The organic material gathered from the Turiang consisted of one duck egg,[363] 3-4 elephant tusks and one jar of fish bones.[364] Brown and Sjostrand concluded that material found in the aft section of the wreck was for crew use, while the material recovered from the fore is ascribed as trade goods. The jar full of fish bones was found in the forward port side of the Turiang, while all the eggs were found in the aft portion of the ship. The fish has been identified most likely as being a species of *Rastrelliger brachysoma* (Fig 4.1).[365] No gill bones were found in the jar and Brown and Sjostrand suggests that the fish were salted, smoked or dried for transport or trade. The elephant tusks were in such a decomposed state that they were left in situ.

[359] Pearson 1987, p.27
[360] 1987
[361] Lobell 2010; Knudsen 1990; Painter 1991; Rollo et al. 2002; Stücker et al. 2001
[362] Brown & Sjostrand 2000; Sjostrand & Barnes 2001 For exact counts (if available) please refer to Appendix 3.
[363] One Thai earthenware jar contained many eggs, but only one unadulterated sample was brought to the surface and catalogued.
[364] Please refer to Appendix 3 for exact counts.
[365] Brown & Sjostrand 2000, p.18

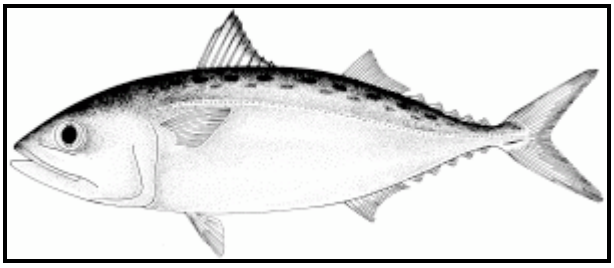


Figure 4. 1: Sketch of *Rastrelliger brachysoma*.
(Food and Agriculture Organization of the United Nations)

Bakau (1410-1430CE)[366]

The organic material of the Bakau wreck comprised of two jars of spices[367], three animal bones, one lacquered box and six pieces of wood.[368] There is no record as to where in the excavation site this material was recovered from and no detailed descriptions of the material were published.

Rang Kwien (1400-1430CE)[369]

Organic artefacts on the Rang Kwien consisted of duck eggs, mangrove crabs, and animal bones. Similar material included in the accession inventory but never published were two ivory boxes and one wooden tuner for a stringed instrument.[370] The only photographic evidence of this material appears to be the wooden tuner. No other photos exist of this material.[371]

4.2.2 Middle Ming Wrecks

Ko Si Chang III (1450-1487CE)[372]

The organic material from the Ko Si Chang III comprised of "a group" of duck eggs, "several" elephant tusks, Areca nuts (Fig. 4.2) and one wooden handle. The eggs of the Ko Si

[366] Flecker 2001b; Liow 2013 For exact counts (if available) please refer to Appendix 3.
[367] Samples were recently identified by Dr Cristina Castillo at University College of London as star anise. See below.
[368] One wooden "handle", one wooden stick, and four unidentified wooden "objects".
[369] Intakosai 1983; Intakosai 1984 For exact counts (if available) please refer to Appendix 3.
[370] (Underwater Archaeology Division, Chanthaburi n.d.)
[371] Jeremy Green (1987) mentions that Areca nuts were part of the assemblage of the Rang Kwien, but Intakosai (1983, 1984) does not claim this in any published work of the Rang Kwien. No photographic or documented evidence from the Underwater Archaeology Division of Thailand could be produced to corroborate or contradict this statement.
[372] Green et al. 1987 For exact counts (if available) please refer to Appendix 3.

Chang III were recovered from one earthenware jar. The Areca nuts were strewn about the site, although one was found within an earthenware jar.[373]



Figure 4. 2: Areca nut/Betel nut (*sp. Areca catechu*). (darchanenterprise.in)

Lena Shoal (1487-1505CE)[374]

The organic material recovered from the Lena shoal comprised of palm leaves and bamboo fibres, spices, Areca nuts, nearly 80 Elephant tusks, and five lacquer ware boxes. The assemblage also consisted of nearly 50 black and white shell discs. The palm leaves and bamboo fibres were the materials used to store and carry the iron ingots that were found in the hold.[375] The leaves appear to be braided to form "racks" in the hold to contain the iron ingots. The ingots were then secured together with the bamboo fibres into bundles of ten.[376]

Peppercorns were found in one blue-and-white box within the assemblage,[377] and the tusks were strewn throughout the entire site. Between the initial survey and the actual recovery project, nearly all of them were looted.[378]

Santa Cruz (1487-1505CE)[379]

The organic material from the Santa Cruz consisted of one coconut shell and one unidentified nut. Additionally, one piece of lacquered wood[380], one lacquered box, five wooden boxes[381] and 13 wooden objects were recovered.[382]

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[373] Green et al. 1987
[374] Goddio et al. 2002; Orillaneda 2013 For exact counts (if available) please refer to Appendix 3.
[375] See Chapter 3.
[376] Goddio et al. 2002, p.40
[377] Goddio et al. 2002, p.117,249
[378] Goddio et al. 2002, pp.248–9
[379] Orillaneda 2012; Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996; Orillaneda 2013 For exact counts (if available) please refer to Appendix 3.

4.3 Object Biographies

4.3.1 Fibrous Materials

Palm Leaves

Palm leaves were found in the assemblage of the Lena Shoal. They appeared to be braided and used as dividing racks between layers of iron ingots.[383] Palm leaves are ubiquitous throughout Southeast Asia, and it is quite common to use the leaves of the palm tree in a number of ways. In some instances, they can be used as containers for foodstuffs (Fig 4.3) or woven into baskets and buckets. Perhaps the oldest use for this material is in thatching (Fig 4.4).[384]



Figure 4. 3: Palm leaf parcels from Indonesia. (dreamstime.com)



Figure 4. 4: Woven palm leaves from roofing. (www.kamats.com)

According to the Food and Agriculture Organization of the United Nations, there are 17 genera of the family *Arecaceae* that have been identified as being used in the making of thatch (used in roofing and in matting) in Southeast Asia.[385] Table 4.1 lists the geneses and species of palms in Southeast Asia, and where they are endemic to the region.

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[380] The line item in the assemblage inventory does not distinguish if this is a fragment of lacquer ware, or simply a stick that has been lacquered. Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996

[381] These were identified in the artefact inventory as being, "round wood", "boxes", or "possibly cover jar". It is possible that they are lacquered boxes, but not identified as such. Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996

[382] One wooden "implement" and 12 unidentified wooden objects.

[383] Goddio et al. 2002, p.40

[384] United States Department of Housing and Urban Affairs 1972; Killmann et al. 1989

[385] Johnson & Nations. 1997; Nations. 2014

Table 4.1: Southeast Asian Palms documented in the use of thatching/matting[386]

Scientific Name	Distribution
Eugeissona brachystachys	Peninsular Malaysia (endemic)
Johannesteijsmannia altifrons	Sarawak, Peninsular Malaysia, Sumatra. Thailand
Licuala. Orbicularis	Sarawak
Livistona robinsoniana	Philippines: Polillo (endemic)
Pholidocarpus kingi	Peninsular Malaysia (endemic)
Pholiocarpus monocrocarpus anus	Peninsular Malaysia, Thailand
Pinanga cochinchinensis	Vietnam (endemic)
Pinanga punicea var. punicea	Indonesia: Moluccas, Irian Jaya
Areca macrocalyx	Indonesia: Irian Jaya
Borassus flabellifer (syn. B. Sundaicus)	widespread as native & cultivated species
Corypho lecomtei	Vietnam; Thailand
Corypho utan (syn. C elata)	Indonesia: Java, Kalimantan, Sulawesi, Sumatra; Malaysia: Peninsular, Sabah; Philippines
Eleiodoxa conferta	Malaysia: Peninsular, Sarawak, Sabah-, Brunei; Singapore-, Indonesia: Kalimantan, Sumatra; Thailand
Eugeissona tristis	Peninsular Malaysia: Thailand
Eugeissona utilis	Borneo
Licuala peltata	Thailand; Myanmar
Licuala spinosa	Malaysia: Peninsular, Sarawak, Sabah; Brunei, Indonesia: lava, Sumatra; Philippines; China, Thailand
Livistona rotundifolia Var. Rotundifolia	Indonesia: Moluccas, Sulawesi; Borneo; Philippines
Metroxylon sagu f longispinum	Indonesia: Irian Jaya, Moluccas; Philippines: Mindanao
Nypa fruticans (monotypic)	widespread in coastal areas
Phoenix acaulis	Myanmar ‘ Thailand; Vietnam
Phoenix loureirii	China-Thailand
Phoenix paludosa	Peninsular Malaysia- Indonesia: Sumatra Thailand: Vietnam
Phoenix sylvestris	Myanmar

We do not know which species of palm leaves were associated with the Lena Shoal because they were only identified to the nearest order (*Arecaceae).* This is unfortunate as there have been archaeobotanical[387] and chemical[388] methods used to identify the genus and species of

[386] Johnson & Nations. 1997; Nations. 2014
[387] Thomas 2014
[388] Sirichai & Kulpanthada 1992

palm leaves from archaeological contexts. If one of these methods had been used to identify the palm leaves of the Lena Shoal, there is the possibility of establishing where this material comes from. Given its associative context with the iron ingots on the wreck, the palm leaves could coincide with the area from which the iron was being sourced. This would assume that the iron ingots were packed at a port close to their place of production; otherwise we would be looking at packing from an emporium where the iron ingots were laded. This may reflect an interconnection between these types of material, and possibly a more concrete idea where the material is originating from, along with a more detailed account of its trading route. Due to the large botanical footprints of some of the types of leaves, it could be difficult in narrowing the sources down geographically, but here there is the opportunity to study a material in greater detail and to enhance our interpretations of the cargo of the ship.

Bamboo

Bamboo fibres were used in lashing together the iron ingots of the Lena Shoal in groups of ten (Fig. 4.5). Bamboo is another material that is widely available throughout Southeast Asia, and commonly used in many forms. An example of bamboo lashings is shown in Fig. 4.6. This is the only recorded instance of bamboo lashings from an underwater excavation. Bamboo was recorded in the hold of the Pattaya wreck in the Gulf of Thailand. It was observed as not being part of the cargo, but used as building material on the inside of the ship. It appeared to be part of a wall. [389]



Figure 4. 5: Bamboo cordage in concreted iron from the Lena Shoal. (Goddio, 2002, pg. 40)



Figure 4. 6: Bamboo lashings. (Aachen.de)

[389] Howitz 1977

The only historical account on the uses of bamboo in Southeast Asia was Ma Huan's description of the anchor cables of the treasure fleet.[390] Like the palm leaves, there is a similar chance of a relational connection between the iron ingots and the bamboo strips if the material can be properly identified. However, identifying the bamboo species solely by the strip samples may be a complicated process. Presently, the United Nations Environment Programme's World Conservation Monitoring Centre has identified 269 different bamboo species in Southeast Asia alone.[391] If we incorporate the species found in China as well, then the number of different species of bamboo jumps to 889. To properly identify these species, it is dependent upon criteria such as leaf type, culm type (stem), seed type and rhizomes (roots).[392] Since the culm is the only part of the sample that has been identified, it is not likely that the samples can be attributed to a specific species. It may be possible to identify the material to the genera, which still gives us some capacity to make a referential connection between the bamboo lashing material and the iron ingots that they bound together.

4.3.2 Foodstuffs

Eggs

Eggs were present in the assemblages of the Turiang,[393] the Rang Kwien, [394] and the Ko Si Chang III. [395] The egg samples from all three sites were found inside storage jars. All the samples were simply identified as duck eggs, yet in each case, no details were given as to how this was determined (Fig. 4.7). Since the shells of duck eggs differ from chicken eggs in terms of size and porosity, it is assumed that this was the interpretive standard that was used to determine the type of egg.

[390] Ma et al. 1970
[391] Bystriakova et al. 2001
[392] Guadua Bamboo n.d.
[393] Brown & Sjostrand 2000, p.39
[394] Intakosai 1983
[395] Green & Harper 1983

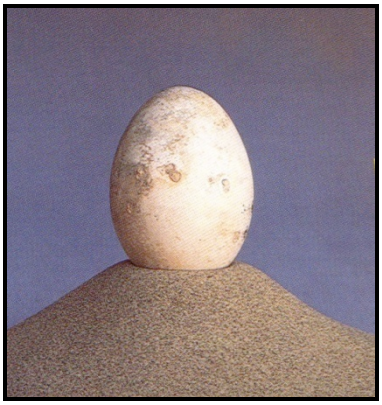


Figure 4. 7: Duck egg from the Turiang. (Brown and Sjostrand, 2000, pg. 39)

According to written sources of the period, domesticated ducks are wildly available. Fei-Hsin observed that ducks and fowls (along with a number of other animals) are "broadly available in large amounts" in Bengal,[396] and that ducks are "produced for trade in the Batak area of Sumatra.[397]

Ma Huan chronicled that domesticated ducks and fowls are present in "Chao-wa" (Java),[398] "Old Haven" (Palembang),[399] as well as "Hsien-Lo" (Siam, Thailand).[400] They are also present in "I-lan" (Ceylon), [401] "Ko-chih" (Cochin), [402] the "Liu mountains" (Maldives),[403] "Tsu-fa-erh" (Dhufar) [404]and "A-ten" (Aden). [405]He noted domesticated ducks as being "plentiful" in "Su-men-ta-la" (Semudera, Indonesia),[406] "Ya-lu" (Aru, Deli)[407] and in "Ku-li" (Calicut).[408]

Huan also noted that that ducks are scarce in "Chan city" (Champa)[409], "Man-la-chia" (Malacca),[410] and in "Nan-po-li" (Lambri, Atjeh).[411] These identifying qualifiers used by Huan represents a difficulty when correlating the archaeology with historical texts. Mills' translation of Huan does not always discern whether "present" means "common", or "present,

[396] Fei 1996, p.76
[397] Fei 1996, p.59
[398] Ma et al. 1970, p.92
[399] Ma et al. 1970, p.101
[400] Ma et al. 1970, p.107
[401] Ma et al. 1970, p.124
[402] Ma et al. 1970, p.132
[403] Ma et al. 1970, pp.146–7
[404] Ma et al. 1970, pp.151–2
[405] Ma et al. 1970, p.157
[406] Ma et al. 1970, pp.115–6
[407] Ma et al. 1970, p.114
[408] Ma et al. 1970, p.137
[409] Ma et al. 1970, p.82
[410] Ma et al. 1970, p.108
[411] Ma et al. 1970, pp.123–4

but scarce". Is it safe to assume when Huan does not write, "eggs are rare", that they must be abundant? The wordplay is too subjective to make these distinctions, but it is an important dialogue to mention because the foodstuff is significant enough for Huan to mention an abundance in certain cases, as well as areas where these items are lacking.

Eggs offer us an interesting perspective on crew rationing and supply on long voyages. The Turiang, wrecked near peninsular Malaysia, the Rang Kwien and the Ko Si Chang III wrecks were found in the Gulf of Thailand. The egg samples found on each of these wreck were stored in earthenware jars. According to the United States Department of Agriculture (USDA), eggs should ideally be stored in a refrigerator, and at the very least, in a cool dry place. Stored this way, raw eggs in the shell have an average shelf life of 3-5 weeks.[412] It is unknown whether these eggs were hard-boiled or raw. Raw eggs have a longer shelf life than hard-boiled eggs; therefore using the longer shelf life is the safest assumption without being able to study the shells in greater detail. Using this precedent, the eggs found on these wrecks would have a nearly similar shelf life. This gives us a radius of travel time to work back from, drawing suppositions about how long these ships could have been away from port. It may be that ducks were kept on-board to produce eggs, but there are no written sources that provide this information. It is also possible that these eggs were a type of pickled, one thousand-year-old' egg, whereby the egg was cured in a mixture of water, ash and lime for up to 45 days. The egg whgite and yolk would reach a gelatinous consistancy and preserve for several weeks to several months, depending upon whether or not the coating remained on the egg.[413] The eggs from these wrecks may have undergone this process, but usually the shell changes colour to signify the change. Without being able to study the effects that the water had on them and whether half a century bleaches the shell, it is likely that they were not pickled. In any case, it makes for an interesting logistical study on crew life in this era. This information would not be greatly helpful for local trading vessels (like the Ko Si Chang III), but for long distance ships this process could be useful evidence to consider the duration of voyaging between ports of call to replenish stocks of food and water.

[412] United States Department of Agriculture 2014
[413] Simmons 1990, pp.364–5

The most detailed record of travel in the area during that time was from Ma Huan. He described the sailing times and identified the ports of call that the Zheng He took during the 7th (and final) voyage of the Treasure Fleet. He described the sailing time as follows:[414]

19 Jan 1431: Sail from Nanking.
3 Feb 1431: Reach mouth of Min River-organized fleet.
8 April 1431: made anchorage at Min River.
16 December 1431: went to Fu-tou-shan (near Fuzhou).
12 January 1432: began voyage.
(Sailed for 16 days.)
27 January 1432: Arrived at Chan city (Qui non in Champa).
(Stayed from 27 Jan-12 Feb 1432. 16 days.)
12 Feb 1432: sailed on.
(Sailed for 25 days.)
7 Mar 1432: arrived in Kua-wa (Surabaya, Java).
(Stayed from 7 Mar-13 July 1432. 98 days.)
13 July 1432: sailed on.
(Sailed for 11 days.)
24 July 1432: Arrived in Chiu chiang (Old Haven, Palembang).
(Stayed from 24 July-27 July 1432. 3 days.)
27 July 1432: Started on.
(Sailed 7 days.)
3 Aug 1432: Arrived in Man-la-chia (Malacca).
(Stayed from 3 Aug- 2 Sep 1432. 30 days.)
2 Sep 1432: sailed on.
(Sailed for 10 days.)
12 Sept 1432: Arrived in Su-men-ta-la (Semudera).
(Stayed from 12 Sep-2 Nov 1432. 51 days.)
2 Nov 1432: sailed on.
(Sailed for 26 days.)
28 Nov 1432: Arrived in His-lan shan (Ceylon).
(Stayed from 28 Nov- 2 Dec 1432. 4 days.)
2 Dec 1432: sailed on.
(Sailed for 9 days.)
10 Dec 1432: Arrived in Ku-li (Calicut).
(Stayed from 10 Dec-14 Dec 1432. 4 days)
14 Dec 1432: sailed on.
(Sailed for 35 days.)
17 Jan 1433: Arrived in Lu-i-Hu-mo-ssu (Hormuz)
(Stayed from 17 Jan- 9 Mar 1433. 51 days.)
9 Mar 1433: sailed on.
(Sailed for 23 days.)
31 Mar 1433: Arrived in Ku-li (Calicut)
(Stayed from 31 Mar-9 Apr 1433. 10 days.)
9 Apr 1433: sailed on.
(Sailed for 17 days.)
25 Apr 1433: Arrived in Su-men-ta-la (Semudera).

[414] Dates have been converted to the Gregorian calendar by Mills. Ma et al. 1970, pp.14–18

(Stayed from 25 Apr-May 1 1433. 6 days)
1 May 1433: sailed on.
(Sailed for 9 days.)
9 May 1433: Arrived in Man-la-chia (Malacca).
(Stayed from 9 May-unknown date.)
28 May 1433: arrived in Kun-lun Ocean (the seas around Poulo Condore).
10 June 1433: arrived at Ka Ga point.
13 June 1433: Arrived in Chan city.
(Stayed from 13 June-17 June 1433. 4 days.)
17 June 1433: sailed on.
(Sailed for two days.)
19 June: 1433. Arrived in Wai-sho-lan (Culao Re).
(Unknown departure date.)
25 June 1433: Saw Nan-ao-shan.
26 June 1433: Saw Wang liang Hui shan (Chapel Island).
30 June 1433: Ch'I t'ou yang (near Ningbo)
1 July 1433: Reached Wan-tieh.
7 July 1433: Reached T'ai ts'ang chiang (Liu Ho).
22 July 1433: Arrived at Peking (Beijing).
27 July 1433: Paid.

The sailing times for this voyage that would pair nicely with the study of fresh foodstuffs is the trip from Fuzhou to Chan city (16 days), Chan city to Surabaya (25 days), Semudera-Ceylon (26 days), Calicut to Hormuz (35 days), Hormuz back to Calicut (23 days), and Calicut to Semudera (17 days). These are the long distance sailing runs that would depend on a large amount of rationing and how well fresh provisions would keep. This itinerary also helps by reporting how long the ships of the Treasure Fleet stayed in various ports of call. It also reveals the ports that can effectively service and outfit a large amount of ships. The presumably large ships of the treasure fleet would need suitable anchorage for their drafts. It is likely only a few ports of call can fit this requirement.

Fish

The bones of the fish *Rastrelliger brochysoma* were identified in a number of earthenware jars in the assemblage of the Turiang. No gill bones were found in the jars; therefore they were most likely cleaned, and either salted or smoked before they were packed. The jars were found at the bottom of the hold, with ceramics piled on top of them. The location of the jars within the ship indicates that they were a part of the commercially traded cargo.[415] Similar fish bones have been found on the wrecks of the Royal Nanhai and the Ko Si Chang I.[416]

[415] Brown & Sjostrand 2000, p.18
[416] Brown & Sjostrand 2000, p.18

There is a small amount of documented trade in dried fish around this time. Ma Huan writes about visiting the Maldives- where dried bonito fish was exported for sale abroad.[417]

Brown and Sjostrand suggest that these fish were smoked and salted under the premise that these bones were packed as a cleaned, prepared, whole fish. Westenberg (1951) describes a similar practise when making pedah siam or pedah-kemburg, a salt-packed, dehydrated fish product from Malaysia, Thailand and Indonesia. *Rastrelliger* is one of the types of fish used in making this dish.[418]

This theory is not implausible, but there are other possibilities that they may have overlooked. These artefacts may be the remnants of the fish sauce trade. Fermented fish products have been consumed since ancient times and the use of fermentation as a preservation method for fish remains an important staple in Southeast Asian cuisine today. Farnworth, in *The Handbook of Functional Foods,* observed that the fish used in the fermentation of fish sauce is still being fermented in earthenware containers today.[419] 'Nuoc-mam' is a type of fish sauce produced in Vietnam using a species of *Rastrelliger* or shrimp.[420] The fish are layered with salt in earthenware jars and buried in the ground for 6 to 18 months. After fermentation, the liquid is decanted to make a high-quality fish sauce. Seawater is added to the fish remains in the jar and boiled down into a concentrate. It is decanted a second time to produce a cheaper, lower quality fish sauce. The presence of fish bones in jars has been taken to be an indication of the presence or shipment of garum on Roman vessels. A second century shipwreck off the Northern Adriatic Coast had amphorae with fish bones in them. The amphorae would have had to be broken apart to remove the fish inside. This indicates that the fish were meant to stay inside the jar and that these amphorae held processed or at least semi-processed fish sauce.[421]

A large number of storage jars from the Nanhai wreck, also found off the east coast of peninsular Malaysia, contained fish bones as well.[422] Given the close proximity of these two shipwrecks, it could support the theory that the material was only locally traded or locally consumed. The fish bones found on these wrecks give us a more detailed picture in the trade

[417] Ma et al. 1970, pp.146–151
[418] Westenberg 1981
[419] Farnworth 2003, p.22
[420] Beddows 1997
[421] Grainger 2011
[422] Sjostrand et al. 2006, p.21

products that are less likely to survive an underwater environment, and/or less likely to be collected during an excavation. There are dozens of products that are mentioned in written works that we have no artefactual evidence of. Opportunities to study an organic product that has been preserved in this situation are rare, and deserve a more critical eye.

Mangrove Crabs

Mangrove Crab shells were found in the assemblage of the Rang Kwien. The Mangrove Crab is a semi-saltwater crab that at present is popularly used in Thai cooking in lieu of salted crabs.[423] *Scylla serrata* is a member of the family *Portunidae* and is known as a "swimming crab", in which the tips of the last pair of legs evolved into flat paddles. The name gives away its strong association to mangrove swamps where they dig their burrows (Fig. 4.8).[424]



Figure 4. 8: Mangrove Crab. (www.seafdec.org.ph/2013/mud-crab-2/)

The Mangrove crab's habitat within Mangrove trees makes it a coastally sourced product. We can say that they are not a natural occurrence at the site with relative certainty, since the Rang Kwien was found 1000 metres off the Coast of Rang Kwien Island and approximately 20 metres deep. The Mangrove crabs' natural habitat is closer to shore and at a shallower depth.

It is not known where the crabs were found in the Rang Kwien, whether they were raw or cooked or processed in some other matter. We also do not know whether this was on board as a tradable commodity or for crew rations. The Australian Department of Agriculture, Fisheries, and Forestry deem that crabs, if kept moist, can live for five days.[425] "Tanking" the crabs (immersing them in a semi-salt water mixture) can double or triple the lifespan of the

[423] Intakosai 1983
[424] Hogarthand & Beech 2001
[425] Mayze, Government, Fisheries Research and Development Corporation, et al. 2013

crabs, but the water must be changed and aerated often.[426] Given the short shelf life of the crab, I would suggest that this was part of the sailor's diet, but a more detailed study of the product is necessary to develop a more informed hypothesis.

Bone

Three isolated bones were found in the assemblage of the Bakau. They appear to be bones belonging to a fowl of some type. No official analysis has been conducted on the material, and nothing has been published on where on the wreck these were found. This is proof that fowl were on board, which lends credence to the theory that the duck eggs mentioned previously could have been laid by birds kept on board. During fieldwork it was possible to examine the bones, which revealed that they are leg bones. They appear to have no scorch marks, so it is unlikely that they were cooked.

Pig bones were identified in the inventory of the Rang Kwien. No exact counts were given, and they do not appear to have been catalogued alongside the other finds. We also do not know which bones have been found, or whether they are from live pigs or butchered meat. Smoked or salted meat could last a long time as crew food. According to the *Ying-yai Sheng-lan*, pigs are present and widely traded in Java[427], Champa[428], Palembang[429] and Siam.[430] They are present but scarce in Indonesia[431] and Bengal.[432] Pigs are non-existent in Aden.[433]

The presence of pig bones is an interesting aspect of these assemblages. One of the tenets of Islam is a strict avoidance of pork products. It is understandable why Ma Huan does not see pigs in Aden, since most of the people in the country were practising Muslims. At the time there was a faith based trading network whereby Muslims supply Muslims. Such a network was observed by Villiers in the 1930's in the Indian Ocean, who notes that crews were regularly either all Muslim or all non-Muslim.[434] The Rang Kwien was a Chinese built ship, which would suggest that at least some of that crew was non-Muslim. Additionally, although Zheng He was a Muslim, the whole crew of the Treasure Fleet could not have been entirely Muslim. Consequently, we should not rule out the possibility that there was a multi-faith

[426] Mayze, Government, Corporation, et al. 2013
[427] Ma et al. 1970, p.92
[428] Ma et al. 1970, p.81
[429] Ma et al. 1970, p.101
[430] Ma et al. 1970, pp.103–4
[431] Ma et al. 1970, p.121
[432] Ma et al. 1970, p.162
[433] Ma et al. 1970, p.157
[434] Villiers 2006, p.7

community on the Rang Kwien. Were Chinese crews typically more diverse than Indian Ocean or Southeast Asian crews? In any case, it offers an interesting perspective into crew life, diet, and rationing that is rarely seen at this point in the South China Sea.

4.3.3. Spices

Pepper

Black peppercorns were only found in the assemblage of the Lena Shoal. Even though there was an image of the material in the "Plant and Animal Remains" section of the Lena Shoal catalogue, no reference to the material (Fig. 4.9) was made in the section. The only reference to the material was made by Monique Crick in the ceramics chapter, when she was describing that the peppercorns were found in a blue-and-white oval box (Fig. 4.10).[435] These porcelain boxes mimicked metal boxes manufactured in the Near East, and were often used as gifts for important people.



Figure 4. 9: Peppercorns from the Lena Shoal. (Goddio, 2002, pg. 249)



Figure 4. 10: Blue-and-white oval box. (FEFNA)

The peppercorn on the Lena shoal represents an interesting amalgam of trade goods. Black pepper at this time has largely been attributed as being sourced from India.[436] Ma Huan observes that black pepper is "the only" product extensively cultivated in Chola[437] and in Calicut[438] in South Asia. According to Anthony Reid, however, by 1500CE pepper was

[435] Goddio et al. 2002, p.117
[436] Goddio et al. 2002; Shaffer 2013; Ma et al. 1970
[437] Ma et al. 1970, p.135
[438] Ma et al. 1970, p.143

being produced in Aceh, Sumatra, Pahang and Kedah on the Malaysian Peninsula, and in northwest Java and southwestern Sumatra near the Sunda strait.[439]

In this instance, we have a trade product harvested somewhere between India and Indonesia, contained within a Chinese manufactured ceramic box, obviously bound for markets outside of China. When the pepper was put into the porcelain container is dependent upon where the porcelain box was located within the shipwreck. If it was inaccessible, the material was likely filled and loaded wherever the Lena picked up the Chinese porcelain. If the boxes were accessible, then the merchants would have had a plan in place to unload the ceramic cargo and fill the containers along its travels in Southeast Asia. There is little other material within the assemblage that suggests that the Lena Shoal travelled to India to pick up pepper.[440]

Since the Lena Shoal was identified as a Southeast Asian-style junk, it is quite plausible that the pepper was a part of the cargo before the blue-and-white ceramics. This would suggest that the pepper was loaded into the box when the Chinese ceramics were obtained, wherever that may have been.

Star Anise

Star anise (Fig. 4.11) has been identified in the assemblage of the Bakau wreck. Flecker mentions that organic matter was present in some of the jars, and suggested getting them identified.[441] Analysis of the material was never conducted. After obtaining an inventory of the Bakau assemblage, I received permission to take samples (accession numbers MW-9 and MW-28) of the organic material in order to conduct archaeobotanical analysis.[442] I collaborated with Dr Cristina Castillo of the University of London to investigate the material. Her findings reported that both of these samples are star anise (*Illicium verum* Hook. f.) (Figs. 4.12, 4.13).

[439] Reid 1993, p.9
[440] The only questionable material in the assemblage of the Lena Shoal was the copper repoussé wares, which have a chance of originating from India (See Chapter 3). The ceramic assemblage would have a lot less Chinese porcelain in it if the boat did in fact reach India.
[441] Flecker 2001b
[442] Liow 2013



Figure 4. 11: Star aniseed. (www.dreamstime_xl.com)

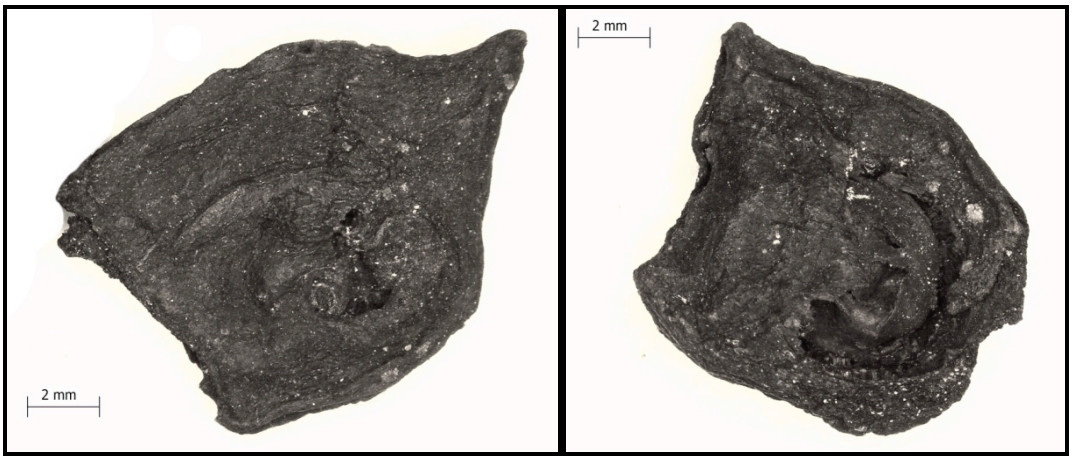


Figure 4. 12: Whole follicles from sample MW-9. The image on the right shows the seed inside the follicle. (Castillo and Fuller)



Figure 4. 13: Fragments of follicles from M8-28. (Castillo and Fuller)

This spice was also found in a spouted jar from the Belitung shipwreck in Indonesia.[443] The Belitung shipwreck was dated using associated artefacts and direct dating of the organics, including the star anise. The star anise radiocarbon date is 670-890 cal. AD, which is earlier than the Bakau shipwreck. Therefore, the star anise found at Belitung would be the earliest documented find for this spice on a shipwreck. However, Flecker identifies the star anise as *Illicium anisatum* L. (Japanese anise). Unfortunately, *Illicium anisatum* has in the past been used to denote *Illicium verum* and is considered a synonym.[444] It follows that the identification *Illicium anisatum* from the Belitung shipwreck may quite simply have been used as a synonym of real star anise. However, without proper examination of the samples, it is impossible to ascertain the identification of the Belitung shipwreck star anise. Both star anise and Japanese anise are of economic importance although the latter is poisonous and is not used as a spice but for medicinal purposes.[445] The main product derived from Japanese anise is its essential oil, although star anise has a higher content of essential oil compared to Japanese anise. Castillo suggests that the Beilitung wreck is more likely to have star anise (*Illicium verum)* in the assemblage rather than Japanese anise (*Illicium anisatum)* because star anise is economically a more profitable and important spice at the time.[446]

The star anise from the Bakau is the first recorded identification of it datable to the Ming Dynasty shipwrecks, and only the second recorded example in Southeast Asian shipwrecks as a whole. It certainly proves that the trade in star anise has a long tradition in the South China Sea and the Indian Ocean. There is no written reference to the star anise trade in historical sources. It is likely due to the fact that these sources are, first and foremost, Chinese accounts of international trade and politics; what they strive to chronicle in their accounts is the observable exports of other regions, rather than what products they are exporting from China to trade. The chroniclers know all about star anise thus feel no need to document what is known. It is a common trope in all of the historical documents pertaining to maritime trade at this time.

A next step in the analysis of this material would be to get these samples radiocarbon dated, to further support or refute the other datable evidence on the Bakau.

[443] Flecker 2001b; Flecker 2001a
[444] Royal Botanic Gardens Trinidad 1888
[445] Dasuki 2001
[446] Castillo 2014

4.3.4 Ivory

Elephant Tusks

Tusks were present in the assemblages of the Turiang, the Ko Si Chang III and the Lena Shoal (Fig. 4.14). Teeth and ivory are the most mineralized and the parts of animals most likely to be preserved. This is due to the fact that they are mostly made up of a high percentage of calcium phosphate.[447] Elephant ivory has been classified as 65% inorganic (calcium phosphate) and 35% organic (collagen and elastin) material.[448] The calcium phosphate is an inorganic compound, therefore the organisms that breakdown organic material is less likely to break the material down effectively.



Figure 4. 14: Ivory tusks from the Lena Shoal. (Goddio, 2002, pg. 249)

All of the ivory from the Turiang, as well as most ivory samples from the Ko Si Chang III and the Lena Shoal were left in situ. Individual samples were brought up from the latter two wrecks. The ivory samples for the Ko Si Chang III are at the Western Australia Museum, while the ivory from the Lena Shoal is located in the National Museum of the Philippines. Little study has gone into the ivory samples, yet all the sources agree that the ivory most likely came from mainland Southeast Asia.[449]

Written accounts describe the trade of ivory between the Indian Ocean and the Far East. According to the Chau Ju Kua, ivory comes from several countries of the "ta-shi" (Arabs) and the countries of "Chon La" (Cambodia) and "Chan Chong" (Annam).[450] Zhao also notes a striking difference between tusks coming from lands near the Indian Ocean and those coming from mainland Southeast Asia. Tusks coming from Arab lands have a "clear-white"

[447] Florian 1987
[448] Webster 1958
[449] Green et al. 1987
[450] Hirth & Rockhill 1911, p.232

colour and defined streaking, while tusks supplied by markets from mainland Southeast Asia appear to have a reddish tint. Southeast Asian tusks also are smaller than their Near Eastern and South Asian cousins.

None of the above sources mention a colour difference or tinting of the recovered samples. It could show a lack of study of the material. It could also demonstrate assumptions made by the investigators. They may have assumed that all the tusks are white because they are unfamiliar with reddish tinted ivory. They also may have thought that the reddish tint is a condition due to deterioration in seawater. We do not know exactly how the aqueous environment changes the tusks over time. This dearth of information demonstrates that a reanalysis of the existing material is necessary. Comparative studies of similar material found on terrestrial sites may help us identify the differences in tusks, and give us more detail about how these artefacts interact with the aquatic environment.

4.3.5 Nuts

Areca Nut

Areca nuts were identified in the assemblages of the Rang Kwien, the Ko Si Chang III and the Lena Shoal (Figs. 4.15, 4.16). The Rang Kwien and the Lena Shoal have similar issues with the documented evidence of the Areca nut. There is a reference in the text to Areca nuts being collected from the Rang Kwien, [451] but no photographic or inventory data to back up the claim. The documentation of the Areca nuts from the Lena Shoal has the same deficiencies as the documentation of the peppercorns. Areca nuts are mentioned as being found in blue-and-white oval boxes on the ship,[452] but no reference to the material is made in the "Plant and Animal Remains" section.

[451] Intakosai 1983
[452] Goddio et al. 2002, p.117



Figure 4. 15: Areca Nuts. (darshanenterprises.in)

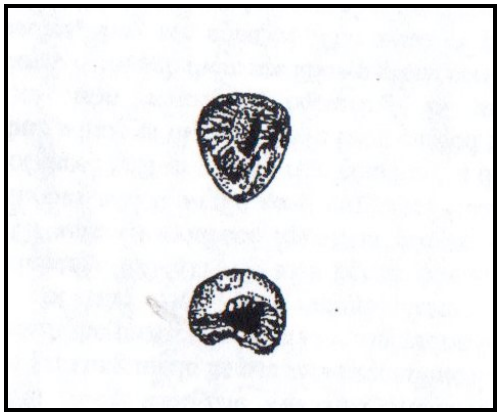


Figure 4. 16: Areca Nut from Ko Si Chang III. (Green et al, 1987)

Areca nut (or betel nut) was widely cultivated and used throughout Southeast Asia in numerous applications. Widely documented in the 15th Century, both Ma Huan and Fei-Hsin observed that it was (and still is) commonly rolled up in betel leaf and chewed as a mild narcotic in Champa, [453] Bengal,[454] and, Ceylon.[455]

Some communities in Java mix them with lime made from clamshells.[456] The lime is designed to score the inside of the mouth thereby "speeding up" the natural chemicals of the Areca Nut. They are used in marriage rites in Java[457] and Siam.[458]

Zhao Rugua observed that Areca nuts were used medicinally in Coromanel, Hainan and in the Philippine Islands. He also notes that wine from the nut was fermented in Sumatra and Java.[459] Fei-Hsin recalled an account of using Areca nuts in Buddhist worship. Locals in Surabaya, Java leave out Areca nuts (along with other products) to honour ancestors pertaining to a local Buddhist myth.[460]

This is another aspect of South and Southeast Asian historical culture that needs more study; not only to understand the cultural aspects surrounding Areca nut uses, but physically as well. We cannot know definitively whether these were trade goods or just a stimulant used by the crew. It is conceivable that areca nuts were in many of the jars as a trade good. As mentioned

[453] Ma et al. 1970, p.82; Fei 1996
[454] Ma et al. 1970, p.162
[455] Ma et al. 1970, pp.130–1
[456] Ma et al. 1970, p.92
[457] Ma et al. 1970, p.93
[458] Ma et al. 1970, p.105
[459] Hirth & Rockhill 1911, p.214
[460] Fei 1996, p.49

in the previous chapter, the areca nuts were a complimentary component used with the lime pots found on the Ko Si Chang III and were certainly part of the Southeast Asian sailor experience. Archaeological research would benefit from a modern ethnographical study of the product, to then piece together any other ethnohistorical accounts. This would paint a more complete picture of the product, helping us to understand its connection with these societies.

Physically we need to gain better access to the archaeological material in order to identify the exact species of Areca. The majority of the species of Areca has been reported from the Malay Archipelago, the Philippines and other East Indies islands. Bavappa, studying the distribution pattern of the Areca species, observed that the contiguous areas of Malaya, Borneo and Celebes have a maximum of 24 species of the Areca palm, the greatest diversity in the region.[461] Archaeobotanical evidence of the Areca may show a specific species being traded, or it may clarify that different Areca species is being used for very different things.

Coconut

One coconut shell was found in the assemblage of the Santa Cruz. No photos exist of the material, and its condition and location are unknown. This is another opportunity where further research could help us learn more about archaeobotany and trade goods. Coconut shells (endocarps) are rather resilient; they have the capacity to preserve well in the archaeological record.[462]

Coconut populations can be differentiated in two main geographical groups based on molecular markers:[463]

(1) The Pacific group, which covers a broad area, ranging from Southeast Asia to the South Pacific and into the West coast of America; and the

(2) The Indo-Atlantic group that includes India, Africa, the Caribbean islands and the Atlantic coast of America.

Archaeobotanical or molecular analysis on this sample could highlight which type of coconut population is present on the Santa Cruz, though it is most likely a "Pacific Group" coconut shell.[464] Chinese chroniclers discussed countries that dealt in coconut from both South and Southeast Asia. Ma Huan described a thriving coconut cultivation, preparation, and trading

[461] Bavappa et al. 1982
[462] Harries et al. 2004
[463] Batugal et al. 2009
[464] Pickersgill 2004; Harries et al. 2004

practice in the Indian Ocean communities of Southern India, [465] Ceylon, [466] Calicut,[467] and in the Maldives.[468] Fei Hsin noted the trade of coconuts in the Nicobar Islands, [469] in Palau Aur, [470] and Pahang, [471] in Malaysia, Kedah, [472] and Janggala in Java.[473] In all of these places; oil, sugar, milk and wine are all manufactured from the coconut for domestic consumption and for external trade.[474] Coconuts are a good type of sailing provision. It provides liquid and food as well as being self-contained. Additionally, it could be a valuable trade product.

4.3.6 Shell

Seashells are a mixture of organic and inorganic material, comprised of an organic matrix of carbon, mixed with an inorganic mineral to create a hard, shell-like consistency. Because it has a portion of organic material in it, I have chosen to list this product in the organics chapter rather than the mineral chapter.

Shell

Forty-five shells discs were documented as part of the Lena Shoal assemblage (Figs. 4.17, 4.18). They were a mixture of black "hemispherical-shaped" shells and white "disc-shaped" shells, polished and worked into pieces of some sort. No identification analysis of the shells has been done, which Goddio suggests that they (specifically the black ones) are likely game pieces for the Chinese game, "Go" or "wei-qi".[475] The game has a long history in China, with textual records claiming that the game was being played as early as the 4th Century BCE.[476] One Chinese stone wei-qi board was recovered from an excavation, which dates to the before 200 CE.[477] A silk tapestry of a woman playing the game was found in Turfan, which dates to the Tang Dynasty.[478]

[465] Ma et al. 1970, p.129
[466] Ma et al. 1970, p.132
[467] Ma et al. 1970, p.143
[468] Ma et al. 1970, p.149
[469] Fei 1996, p.62
[470] Fei 1996, p.84
[471] Fei 1996, p.88
[472] Fei 1996, p.87
[473] Fei 1996, p.93
[474] Ma et al. 1970; Hirth & Rockhill 1911
[475] 2002, p.254
[476] Fairbairn 1992
[477] Watanabe 1977, p.119
[478] Watanabe 1977, pp.119–20



Figure 4. 17: Black hemispherical shell. (Goddio, 2002, pg. 254)



Figure 4. 18: White shell disc. (Goddio, 2002, pg. 253)

It may be a simple job to identify the shell pieces into a typology. Since seashells and molluscs thrive in many places underwater, it would be harder to ascertain the location of where these creatures thrive between the Far East and the Indian Ocean. The game itself is Chinese in nature; it could be that the shells were harvested from Chinese waters. Yet the game itself acts as a technological and processual transfer in operation, spreading the game concept as well as the materials wherever it is introduced. Games may well have been popular on board ship as a form of leisure. It would require studying the game itself and its pieces throughout history, and comparing these pieces found on the Lena Shoal. These types of items do not seem to be a common find in shipwreck assemblages, which may suggest that the game was not as popular outside of China.[479] Little is known about the games' presence outside of East Asia. There are no historical accounts of wei-qi being played by cultures in Southeast Asia in the Yuan and Ming Dynasties. If this is a leisure item, its story brings us away from the trade-based narrative of so many ship reports and back towards the crew and their seafaring lives.

5.3.7 Lacquer ware

Lacquer ware was found in the assemblages of the Lena Shoal, the Santa Cruz and the Ko Si Chang III. The Ko Si Chang III and the Santa Cruz each had one piece of lacquered wood on them (Fig. 4.19). The Lena Shoal had approximately five pieces; one comb, and between one

[479] Further research is needed in Chinese Archaeological journals to ascertain the archaeological footprint (both on land and underwater) of this type of artefact.

and four containers with lids (Figs. 4.20, 4.21).[480] Crick reported the comb as being found inside a blue-and-white jar.[481]



Figure 4. 19: Lacquerware from the Santa Cruz. (FEFNA)





Figure 4.20, 4.21: Lacquerware samples from the Lena Shoal (Goddio, 2002, pg. 256)

The centres of lacquer production shifted from eastern to southern China during the Five Dynasties (907 CE- 960/979 CE). The provinces of Zhejiang and Jiangsu became the two most important regions of lacquer ware production, and stayed prominent until the Late Ming Dynasty.[482]

The process of making these wares is very elaborate. Sheets of softwood, after being allowed to dry and mature, are cut into strips of about 3.5 cm. Heat is applied to the strips and bent

[480] Goddio et al. 2002, pp.256–7There were five photos of the lacquer ware on pages 256-7, but no inventory numbers to suggest that they are different items. Therefore it is safe to claim that there were 1-4 lacquer ware boxes on the Lena Shoal.
[481] Goddio et al. 2002, p.117
[482] Kopplin et al. 2008, p.5; Goddio et al. 2002, pp.256–7

into the forms desired. The strips are then glued together in layers and progressively combined to form the container and lid. The piece is then glued again, allowed to dry and sanded. Layers of lacquer are then added, and the piece allowed to dry from a period of a few weeks to a few months. The lacquer is made up of a toxic sap from the East Asian lacquer tree. Cinnabar is then used as a pigment to further preserve and colour the piece since it was the only reactant found that would not compromise the sap.[483]

Lacquer ware is a unique type of artefact that goes against the premise that artful objects are more popular and, therefore, more highly studied. Because these types or artefacts are less likely to preserve, less archaeological study has been conducted on lacquerware from shipwrecks.

5.3.8 Wooden Objects

A series of wooden fragments and objects were identified within the assemblages of the Bakau, the Ko Si Chang III and the Santa Cruz. The wooden inventory of the Bakau was comprised of one wooden stick, one wooden handle and four wooden objects. One wooden object was found in the Ko Si Chang III (Fig. 4.22). The Santa Cruz inventoried five wooden boxes, three wooden handles, one wooden implement and nine wooden objects (Figs. 4.23, 4.24, 4.25).[484]

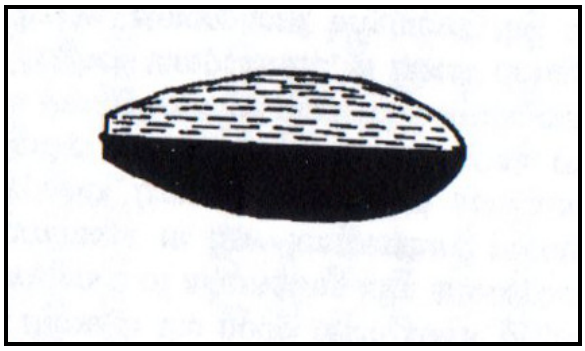


Figure 4. 22: Wooden handle from Ko Si Chang III. (Green et al, 1987)



Figure 4. 23: Wooden handle from the Santa Cruz. (FEFNA)

[483] Kopplin et al. 2008, p.3

[484] The "5 boxes" were identified in the inventory as being "round boxes". It may have been that these are lacquer ware, but not identified as such.



Figure 4. 24: Wooden handle from the Santa Cruz. (FEFNA)



Figure 4. 25: Wooden handle from the Santa Cruz. (FEFNA)

Many of these items were not documented or published. We may not find much information from the fragments, but we may glean information from the other objects on shipboard life during this era. The handles on the Santa Cruz alone show remarkable diversity of material and style. Any type of wood species analysis would possibly give us insight into sourcing regional wrecks. This is another aspect of organic assemblages that requires further study.

4.4 Discussion

When studying organic material from shipwreck assemblages, we know that there are many missing pieces in this puzzle, yet there still are real opportunities to examine facets of maritime trade that are less pronounced than the 'headline' trade in ceramics. In this chapter we discussed materials connected to packing and stowage, (bamboo, palm), non-ceramic traded goods (spices, fish sauce, areca nuts, ivory, lacquer ware), food for crew use (crabs, eggs, spices, fish sauce, pig bone) and possible social aspects of crew life (areca nuts, game pieces).

What little scholarship that has been conducted on material of this type is due to their lack of preservation in salt water. There are other objects in the written record of trade that have not been recovered, but are known to have travelled these routes. That fact simply stresses the case for a greater need to study the material that has managed been preserved in these cases. Zhao Rugua compiled a detailed list of the organic products that Chinese traders were interested in the Chau-Ju-Kua:[485]

[485] Hirth & Rockhill 1911, pp.191–239

- Plant resins like Camphor, Frankincense and Myrrh, Aloe, Dragon's Blood, Benzoin, Dammar Gum, Liquid Storax and Asafoetida.
- Perfumes like Gardenia and Rose Water and Putchuck (*Saussurea costus-root)*.
- Aromatic woods like Gharu-wood (Agarwood), Sandalwood, Laka-wood and Musk.
- Precious woods like Ebony, Sapan wood
- Fibrous materials like Cotton, rattan mats,
- Spices such as Cloves, Nutmeg, Cardamom, Cubebs (Tailed pepper) and Pepper.
- Edibles like Jack fruit, Areca nuts, coconut, Oak-galls (Oak Apple)
- Animal products such as Ivory, Rhinoceros horns, Kingfisher feathers, Parrots, tortoise shells and bees wax.

The maritime archaeological evidence for the trade of this material is scant at best. Pepper, areca nuts, coconuts and ivory were the only materials in this case study that could be cross-referenced with the written account. If Zhao Rugua was exhaustive in his listing of goods destined for Chinese markets, it could suggest that all of the other organic material found in this case study yet not mentioned in the Chau-Ju-Kua be either crew material or trade goods for non-Chinese markets.

4.4.1 Ship Assemblage Narratives

By incorporating the analysis of the organic material and expanding the shipwreck narratives from Chapters 2 and 3, we can see a more nuanced pattern of trade as well as the complexity of some of the material.

The Turiang is a Chinese styled boat that contained ceramics from China, Thailand and Vietnam. Thai wares made up the bulk of the ceramic assemblage; nearly one-and-one-half times (57%) that of the Chinese ceramic material (35%). Vietnamese wares made up the difference (8%). Iron in powder form was present, likely from the iron sand beaches of Sumatra or Java. Organic material from the Turiang consisted of foodstuffs in the form of eggs likely from mainland Southeast Asia, and fish from the Gulf of Thailand. Ivory was also part of the cargo as a trade good, also from mainland Southeast Asia (Fig. 4.26).

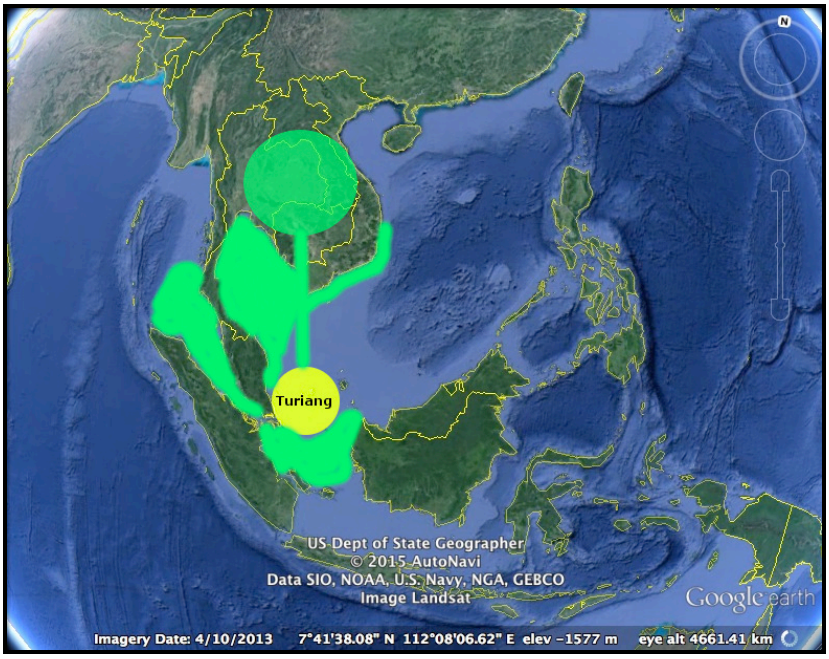


Figure 4. 26: Network of organic material from the Turiang. (Google Earth, additions, B. Fahy)

The Bakau is a Chinese-styled boat that contained ceramics from China, Thailand and Vietnam. Thai wares make up the bulk of the ceramic assemblage (67 %), over double that of the Chinese ceramic material (32 %). Vietnamese wares make up the lowest proportion (1 %). Tin ingots from Malaysia were present in the assemblage, as well as bronze mirrors and tweezers, gongs and coins from China. Iron pots found on board were also manufactured in China. Some metal items like fishhooks, scale chains and weights, and fish, net, and sounding weights, while they cannot be attributed as coming from any specific region, gives clues into life on board. Star anise has been identified as part of the organic assemblage as well as lacquer ware boxes: both from China. Animal bones were also part of the assemblage, likely from mainland Southeast Asia (Fig. 4.27).

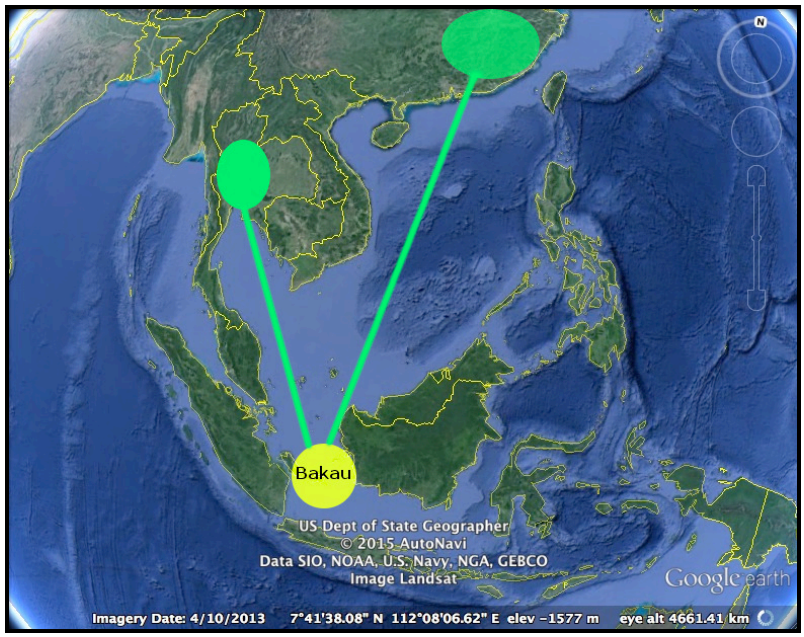


Figure 4. 27: Network of organic material from the Bakau. (Google Earth, additions, B.Fahy)

The Rang Kwien is either a Japanese or Chinese styled junk that contained ceramics from China, Thailand and Vietnam. Thai wares make up the bulk of the ceramic assemblage (75 %) with Vietnamese wares (18 %) and Chinese ceramics (3 %) completing the ceramic makeup. Lead and copper ingots were also part of the assemblage, raw materials likely sourced from Thailand. Chinese items include thousands of minted coins, iron pots, a bronze mirror and a bronze gong. A tsuba from Japan was also recovered. Finery was found on board in the form of jewelled earrings, revealing some of the wealth that travelled through the region. Organic material from the Rang Kwien consisted of foodstuffs found throughout Southeast Asia. Areca nuts and eggs from mainland and archipelagic Southeast Asia were present, as well as mangrove crabs from the coasts of the Gulf of Thailand and South China Sea (Fig. 4.28).

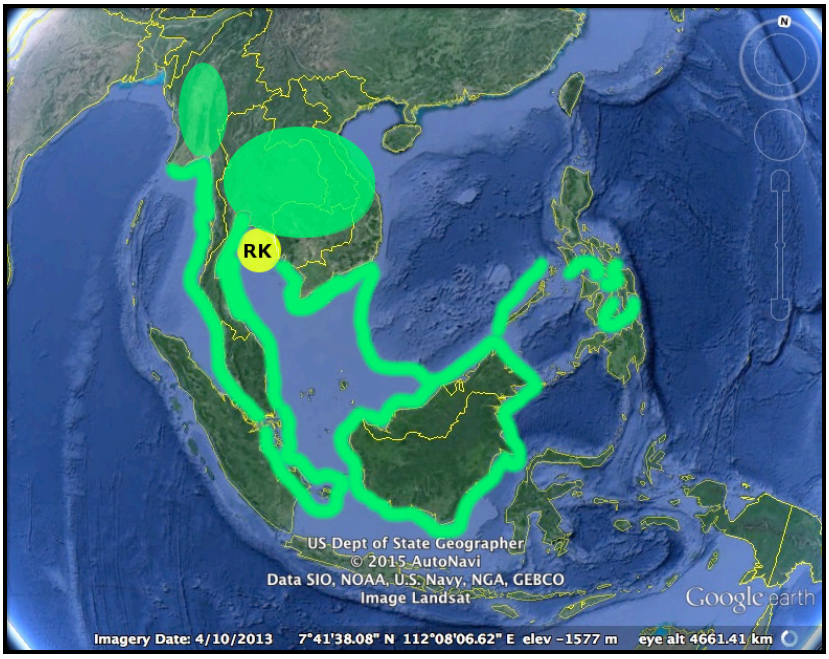


Figure 4. 28: Network of organic material from the Rang Kwien. (Google Earth, additions, B.Fahy)

The Ko Si Chang III is a Southeast Asian-styled junk that contained ceramics from China, Thailand and Vietnam. Thai wares make up most of the ceramic assemblage (95 %). Very few Chinese (1 %) and Vietnamese (1 %) ceramics are part of the assemblage. Lead and copper ingots were part of the assemblage, likely mined in Thailand. Bronze lime containers likely manufactured in peninsular Southeast Asia was found on board as well. Organic material on the Ko Si Chang III consisted of foodstuffs in the form of eggs from mainland Southeast Asia, and Areca nut from all over Southeast Asia and the Indian Ocean. Identified organic commodities from the Ko Si Chang III consisted exclusively of ivory from mainland Southeast Asia (Fig. 4.29).

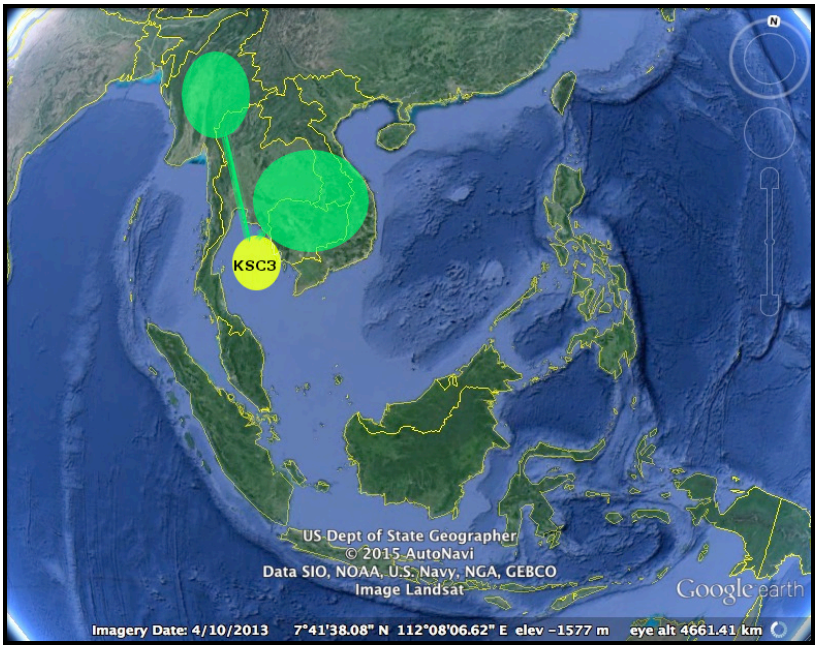


Figure 4. 29: Network of organic material from the Ko Si Chang III. (Google Earth, additions, B.Fahy)

The Lena Shoal is a Southeast Asian-styled junk that contained ceramics from China, Thailand, Vietnam, and Burma. Chinese wares make up the bulk of the ceramic assemblage (71 %) with Thai, (23 %), Burmese (3 %), and Vietnamese wares (1 %) also present. Tin ingots from Malaysia were part of the assemblage. A large amount of brass bracelets, likely manufactured in Peninsular Southeast Asia, was also found. Chinese material included bronze cannons, gongs and coins, as well as iron pots and needles. Organic material consisted of pepper from either India or Sumatra, ivory from mainland Southeast Asia and lacquer ware from China (Fig. 4.30).

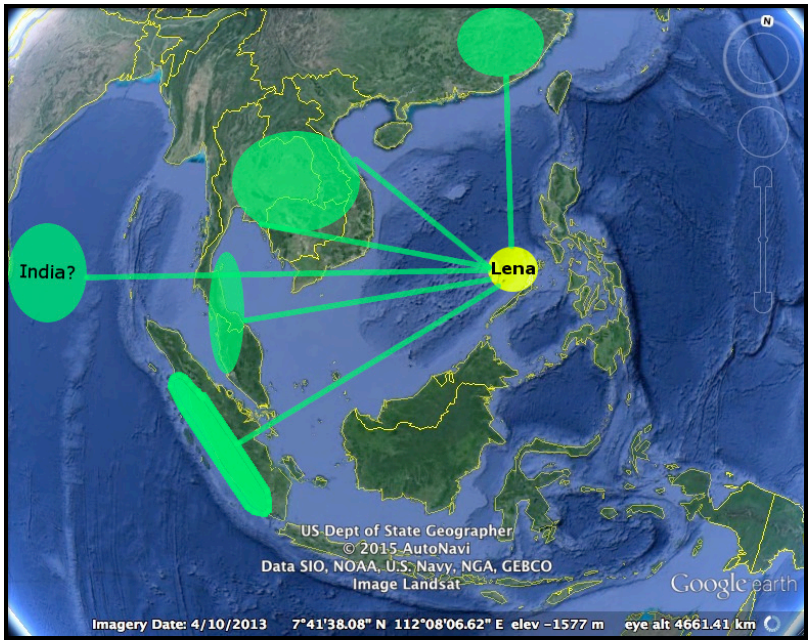


Figure 4. 30: Network of organic material from the Lena Shoal. (Google Earth, additions, B.Fahy)

The Santa Cruz is a Southeast Asian-styled junk that contained ceramics from China (86 %), Thailand (9 %), Vietnam, (1 %) and Burma (1 %). Tin ingots from Malaysia were part of the assemblage along with a large amount of brass bracelets, likely manufactured in Peninsular Southeast Asia. Chinese material included bronze cannons and gongs, as well as iron pots. Identifiable organics from the Santa Cruz appears to be lacquer ware from China (Fig. 4.31).

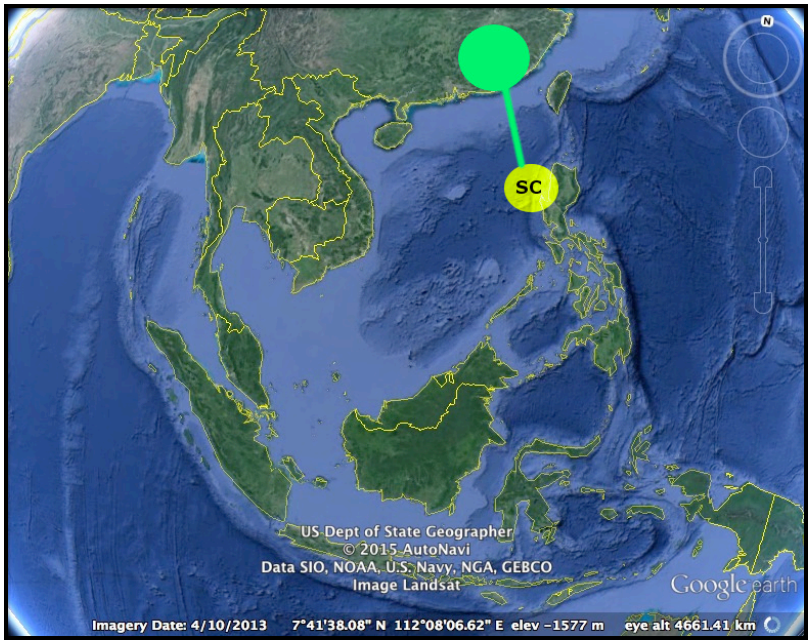


Figure 4. 31: Network of organic material from the Santa Cruz. (Google Earth, additions, B.Fahy)

I presume that all of the excavations were quite thorough. These people are experts in their field. It is likely that there simply was not much organic material to process at these sites. Yet

these items seem as though they are judged as an inconsequential find – either passively or actively. A crew on a treasure hunted wreck like the Bakau assumedly would care less about organics. They do not sell. Yet, organic material was recovered and sold as part of the whole assemblage. Even if organic objects came from the site, if there is not conservation plan in place for that type of material, it is actively regarded as inconsequential. The other wrecks were not sold to the highest bidder. The ceramics were still stressed in the published materials, however. This is due to the scholarly environment they are working in. The organics at best were mentioned peripherally, and at worst, not cited. In Southeast Asia these are simply not studied in shipwrecks, yet they are important pieces in understanding the past. These materials have a strong connection to ceramics. Many of them were stored in ceramic jars. The jars that were found were not always empty. Some of the jars carried smaller ceramics inside them, but some certainly carried organic material to trade partners in South and Southeast Asia. When we ignore this material or the concept of "packaging", we ignore the complete narrative that all of these - the ceramics, the organics, the metals-come from.

The record of the organic material in this study reveals some interesting facets of shipboard life, diet, and trade. The duck eggs, mangrove crabs, and pig bones are likely portions of the seafarer's diet at this time. These items are not mentioned in the Chau-Ju-Kua as an exotic trade product, and given the sailing times during certain legs of the trip, would most likely spoil on the way to China. These objects also were not foreign to China hence there would be less of a desire to obtain foodstuffs that could be acquired locally.

The pepper found on the Lena Shoal, given its location and the amount (a small amount in a blue-and-white box), was probably a personal cache. This amount of pepper could represent a paid wage of the spice. Pepper became a temporary currency in China for a time; records show that Chinese sailors in the fifteenth century were partially paid in pepper.[486] Star anise was a valuable trade good outside of China, as reflected by the material found on the Bakau and the Beilitung. Archaeobotanical analysis of the material has given us proof of the star anise trade in the 14th and 15th Century, further enriching its trading history. The fact that is not mentioned in the written record is simply due to the fact that it was not an exotic import. Further archaeobotanical analysis of the coconuts, the Areca nuts, the palm and the bamboos can tell us more about the products that were found on board these ships.

[486] Prabhakaran Nair 2011, p.2; Tien 1981

Areca nuts and the fish bones are most likely a combination trade good and crew use material. The areca nuts were mentioned as an import to China, but its use was widespread throughout Southeast Asia. Clearly the sailors in the region chewed it. This evidence paired with the lime canisters in Chapter 3 support that theory. The fish bones were certainly part of the crew diet, either as a smoked protein, or as a fermented sauce. If the material could be confirmed as fish sauce with confidence, this was also a likely trade good throughout the region. The ivory tusks were certainly a trade good, because it is a raw material in an unprocessed state, as well as being mentioned in the historical text as such.

We begin to perceive lading methods and processes of the time when we get the chance to study the palm leaves and bamboo fibres. Possible elements of crew social life can be observed when we analyse the pieces of worked shell as game tokens. Lastly, many of the wooden objects can reveal wood sourcing if studied in greater detail. With more scientific analysis on this material, we can paint a broader picture of the people and the items behind the trade at this time.

5.0 Stone, Glass, and Mineral Objects

5.1 Introduction

In this chapter, I will discuss the material from the shipwreck assemblages that do not fit into the previous three chapters. These items are artefacts that are not ceramic, organic, nor metallic. Within the confines of this study, this comprises the stone, glass, and mineral objects found within the assemblages. As with the previous three chapters, I will highlight the objects that make up this diverse category that are contained within each wreck (if any), and then discuss the biographies of each material and how they relate to the larger body of work.

5.1.1 Degradation of stone and mineral materials in an underwater environment

The effect of seawater on stone and mineral objects is related largely to the type and density of the material (or materials) that makes up the artefact.[487] The denser the crystalline network of the stone, the harder it is to weather and erode because water is less likely to get into the structure to break up the network. Igneous rocks, formed when molten lava cools, has a high density and a strong crystalline structure.[488] Sedimentary rocks, due to do their nature of formation (either by compression or cementation) are less dense than that of igneous rocks. Sandstone, for example, is made up largely of quartz and feldspar that is fused together (through cementation) by silicates or carbonates. Limestone is calcite that is cemented together by similar material. Metamorphic rocks are sedimentary rocks that have been transformed through extreme temperature and pressure. These extremes cause a recrystallization of the silicate structure in the rocks resulting in a more dense (thus, stronger) material. For example, marble, is metamorphosed limestone; slate is metamorphosed shale or clays.[489]

The preservation of minerals depends on the chemical combination and its method of storage. An object that contains a high amount of a readily corrosive material (e.g. iron in iron oxide pigment) tends to deteriorate faster than one containing fewer corrosive elements. Minerals

[487] Cronyn & Robinson 1990, p.106

[488] Igneous rocks comprised largely of complex silicates like quartz, feldspars, hornblende and mica. Mica is the only "soft" silicate and easier to breakdown. If the molten material is cooled rapidly, obsidian and pumice can also form.

[489] The exception to this rule is soapstone, which is metamorphosed talc. It is the only "soft" metamorphic rock, but will not be discussed.

and pigments that are left as a solid, unworked piece then tend to fare better underwater than ones that are ground into powders. Therefore pigments are less likely to survive underwater.

Stone and mineral objects found in marine environments can suffer continued abrasion and eventual erosion by seawater and grains of sand. Exposed stone could offer purchase to encrusting organisms, resulting in various degrees of destruction. Bryozoans and barnacles are relatively harmless to the stone surface, but stone-boring molluscs can attack soft and calcareous stones, causing intrusive damage.[490]

5.1.2 Degradation of glasses in an underwater environment

When glass objects come in contact with moisture, the alkali ions are leached out and replaced with protons from the water. The surface layer of the glass becomes dull or iridescent as the layer thins. Water molecules can then seep through the iridescent layer to attack fresh glass underneath. A surface of damp glass can have several weathered, iridescent layers as the water slowly breaks down the material.[491]

The estimated rate of decay of glass in fresh water is approximately 3-5 mm per millennium, with decay being more aggressive in seawater.[492] In fresh water, the hydrogen ions only attack the flux (the alkali ions) of the glass. Seawater breaks down both the flux as well as the silica gel in the glass, therefore the rate of decay could be as much as ten times greater than that of fresh water immersion.[493]

All of stone and mineral material fare better than organic material underwater. Between stone, glass and mineral objects, stone and tends to survive better than glasses and minerals underwater. Due to losses of these types of material in an aqueous environment, much like metals and organics, it structures the archaeological records of the excavated ships by skewing towards artefacts that have a higher survivability, with which often comes the issues of selection and preservation by excavators. Stone, mineral and iridescent glass are usually less attractive and therefore less likely to be collected than ceramics.

5.1 Stone, glass and mineral material from the case study assemblages

[490] Cronyn & Robinson 1990, p.108
[491] Cronyn & Robinson 1990, p.131; Pearson 1987, p.263
[492] Cronyn & Robinson 1990, p.135
[493] Cronyn & Robinson 1990, p.135

The inventories listed below are also detailed in Appendix 4: Stone and Mineral Material Distribution.

5.1.1 Early Ming Wrecks

Turiang (1370-1400 CE)[494]

Several "small chunks" of Sphalerite[495](ZnS) were discovered in ten Suphanburi storage jars (Fig. 5.1).

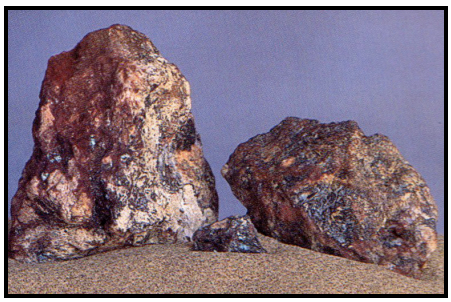


Figure 5. 1: Sphalerite chunks from the Turiang. (Brown and Sjostrand, 2000, pg. 39)

Rang Kwien (1400-1430 CE)[496]

No stone or mineral material was recorded from the artefactual assemblage of the Rang Kwien.

Bakau (1410-1430 CE)[497]

The stone and mineral material from the Bakau assemblage consisted of nine single-round grinding stones, one double-round grinding stone, sixteen stone "blocks" or querns, sixteen stone rolling pins and one ink stone. There were also eleven unidentified stone objects, and seven pieces of red pigment.

5.1.2 Middle Ming Wrecks

Ko Si Chang III (1460-1487 CE)[498]

[494] Brown & Sjostrand 2000; Sjostrand & Barnes 2001 For exact counts (if available), please refer to Appendix 4.
[495] Also known as "zinc sulfide" or "zinc blende".
[496] Intakosai 1983 For exact counts (if available), please refer to Appendix 4.
[497] Flecker 2001b; Liow 2013 For exact counts (if available), please refer to Appendix 4.
[498] Green et al. 1987 For exact counts (if available), please refer to Appendix 4.

No stone or mineral objects were recorded from the artefactual assemblage of the Ko Si Chang III.

Lena Shoal (1490-1505 CE)[499]

The assemblage of the Lena Shoal consisted of "thousands" of beads, [500] eleven marble discs, one marble cylinder, one grinding quern, and one sharpening stone. The assemblage also contained three unidentified pieces of marble, and approximately five ballast stones.

Santa Cruz (1490-1505 CE)[501]

The stone and mineral material from the assemblage of the Santa Cruz is comprised of over one thousand beads, and 43 glass bracelets.[502] There were also three sharpening stones, one stone quern, two rolling pins, one ballast stone, one stone implement, and two unidentified stone objects.

5.2 Object Biographies

5.2.1 Glass Objects

Beads and bracelets

An active trade in beads has long been a part of the economic networks between the regions of India, Southeast Asia and China. The Indus Valley was a leader in the production of carnelian beads as early as 1500 BCE, and the production of glass beads began in the Middle East as early as 2500 BCE.[503] These were widely traded through maritime routes from Africa to Japan.[504] The majority of these beads are compositionally categorized as being made from mineral soda-alumina glass.[505] Carter's research in Cambodia revealed a second type of bead, manufactured by using a lead-potash-silicate recipe.[506] This type of bead was used in China from the sixth century through to the Ming Dynasty,[507] and produced exclusively for export

[499] Goddio et al. 2002 For exact counts (if available), please refer to Appendix 4.
[500] Goddio et al. 2002, p.250 No exact number was given for the amount.
[501] Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996; Orillaneda 2012 For exact counts (if available), please refer to Appendix 4.
[502] Ten of the glass objects were identified as "glass rings", which after careful study by Jennifer Craig were actually glass bracelets. Craig 2014
[503] Ramli et al. 2009
[504] Sleen 1973
[505] Dussubieux et al. 2008
[506] 2011
[507] Brill et al. 1991; Fuxi 2009

to markets in Southeast Asia. [508] A third type of bead recipe, classified as a "high-alumina glass with high concentrations of magnesia" has been found recently in the region, yet so far has only proven to exist from the 15th through 17th centuries. [509]

Some archaeological research has been conducted on other beads found from shipwrecks of this time period. Jun Cayron's visual analysis of the beads from the Pandanan suggested that some of the beads from the wreck share similar technological traits with beads found from Sungai Mas in Malaysia, bolstering the theory that Sungai Mas was once a bead-manufacturing centre of Southeast Asia.[510]

The most comprehensive report on beads from shipwrecks is from Michel L'Hour's Brunei wreck.[511] Thousands of glass beads, fifty glass bracelets and 20 kilos of glass ingots were recovered from this 15th Century wreck found off the coast of Brunei. These items not only suggest that there was a vibrant trade in beads throughout the region, but it also reflects trade in larger pieces of 'raw' glass for subsequent re-melting and making of objects.

The yellow beads of the Brunei wreck were created by softening glass rods and rolling the molten material around a stem. The beads contained high levels of soda-alumina, along with high levels of lead and tin (which give them their opacity). No theory was posited as to where they were fabricated. The blue beads, manufactured using an iron stem plunged into a melting pot and then wrapped in a few layers of molten glass, are said to have come from China.[512]

Of all the objects considered in this thesis, beads are the only artefact type with a research history on par with ceramics.[513] Beads were present in the assemblages from the Lena Shoal and the Santa Cruz wrecks. No exact counts were provided from either example. "Several thousand" glass and stone beads were catalogued on the Lena Shoal; blue coiled beads (Fig 5.2), black spherical beads (Fig. 5.3) and white translucent beads (Fig. 5.4) made up the bulk of its inventory.[514]

[508] Francis 2002
[509] Carter & Beavan 2014
[510] Cayron 2002
[511] 2001b; 2001a
[512] L'Hour 2001b, p.135
[513] For a full annotated bibliography of bead research, see Karklins 2014b; Karklins 2014a
[514] Goddio et al. 2002, pp.249–51



Figure 5. 2: Blue coiled beads from the Lena Shoal. (Goddio, 2002, pg. 251)



Figure 5. 3: Black "pea" beads from the Lena Shoal. (Goddio, 2002, pg. 251)

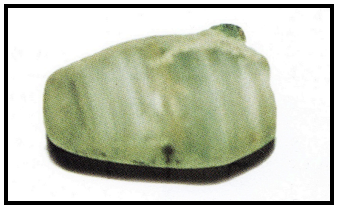


Figure 5. 4: White bead from the Lena Shoal. (Goddio, 2002, pg. 251)

The beads from this wreck were packed into the small ovoid Sawankhalok jars from Tao Maenam Noi (Fig. 5.5). Seven of the jars were found with their contents intact, while individual glass beads found on the sea floor were contextually associated with sherds from this type of jar.[515]



Figure 5. 5: Tao Maenam Noi ovoid jar. (Goddio, 2002, pg. 34)

One brown bead and one blue bead from the Lena Shoal were compositionally analysed using a scanning electron microscope attached to an EDX micro-analyser, with the spectrographic results published as an appendix at the end of the excavation report. The technical interpretation that was put forth formed the hypothesis as to how these beads were manufactured and why certain elements were part of the glass recipe.[516] The brown bead that was analysed comprised largely of a mineral soda-alumina mixture, while the blue coiled bead was a lead-potash-silicate recipe. The blue beads from the Lena Shoal share similar compositional characteristics to the blue-coiled beads from burial jars found in Cambodia

[515] Goddio et al. 2002, p.249
[516] Goddio et al. 2002, pp.266–269

dating to the 15th through 17th centuries.[517] Carter and Beavan's analysis of the blue beads in Cambodian burials reveal that they are made using a lead-potash recipe.[518] Goddio's morphological assessment of the blue bead leads him to conclude that they are manufactured in a similar way to the beads from the Brunei wreck, and likely manufactured in China.[519]

The bead inventory from the Santa Cruz assemblage is confusing to decipher. In a couple of cases, beads found in jar were recorded and cross-correlated with the accessioned vessel they were found in.[520] In most other cases, it seems that the beads were either measured by the "bag", or by weight. It is also not clear as to the colour of all of the beads on record. The best correlation of the bead inventory is shown in appendix 4. There are approximately two thousand beads accessioned from the Santa Cruz. Various colours include clear glass (Fig. 5.6), carnelian (Fig. 5.7), yellow (Fig. 5.8), blue (Fig. 5.9) and black.

Some of the beads measured by bag in the inventory had descriptive comments that could not be referenced to the associated jar that they were found in. For example, one kilo of black and blue beads (inventory no. 11921) had the additional comment of being "found in the jar"; another bag of beads (inventory no. 4) was "Found inside the bowl". No note was made relating to the inventory number of the respective jar or bowl that this material was found in. It is not apparent that the beads were logged together with their respective containers sequentially. Jars that were large enough to contain the accessioned beads were catalogued at ~40 numbers away (above or below) the accessioned beads. Hence, the material found inside of 'a jar' has no associative context to its container. A better-detailed account of where these were found would help us reconstruct the packing of this material.

[517] Goddio et al. 2002, p.269
[518] Carter & Beavan 2014
[519] Goddio et al. 2002, p.269
[520] 25 black beads (inventory no.11386) and 84 carnelian beads (inventory no. 11387) had been recorded as being from a blue-and-white box (inventory no. 11385).



Figure 5. 6: Clear glass beads from the Santa Cruz wreck. (FEFNA)



Figure 5. 7: Carnelian beads from the Santa Cruz wreck. (FEFNA)



Figure 5. 8: Yellow bead from the Santa Cruz wreck. (Jennifer Craig)

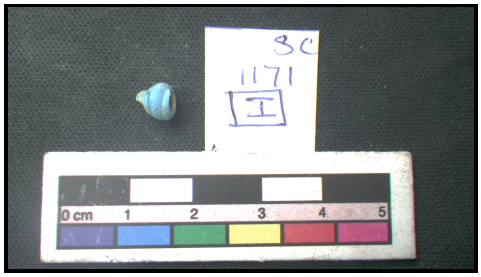


Figure 5. 9: Blue-coiled bead from the Santa Cruz wreck. (Jennifer Craig)

Compositional analysis of the beads from the Santa Cruz has yet to be conducted. Twenty samples of beads were sent to the Field Museum in Chicago to undergo compositional analysis through laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS).[521] The results of this study, however, it not expected to be available until late 2015/early 2016.

The clear glass beads from the Santa Cruz wreck represent a unique find in the assemblage (Fig. 5.10). No clear glass beads have been found on any other shipwreck. They have also not been found in Sungai Mas or in Cambodian burial jars. The clear glass beads that have been found are zoomorphic beads from Bang Kluay and Chiaya (Fig. 5.11). [522] Without compositional analysis on the clear glass material from the terrestrial sites of Thailand and the clear glass beads from the Santa Cruz, we can only employ a visual connection to this material. Stylistically they are different, yet both are transparent. These sites, however, like

[521] Jennifer Craig with McGill University has conducted this study in conjunction with the National Museum of Manila as part of her PhD thesis, "Beads on Boats: digital charts of the dynamic human-environment interaction with Philippine shipwreck bead cargo and seawater currents". Her analysis was conducted in November of 2014, and the results of which are forthcoming.

[522] Phongphanit. 2009

the Santa Cruz, have also been contextually associated with green glass bracelets as well as similar types of ceramics.[523] This suggests that these items have an associative connection and tend to travel in similar circles.



Figure 5. 10: Clear glass bead from the Santa Cruz. (Jennifer Craig)

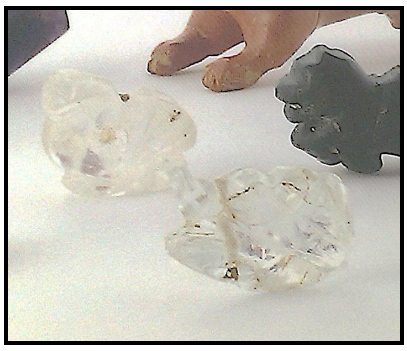


Figure 5. 11: Zoomorphic clear glass beads from Bang Kluay, Thailand. (Phongphanit, 2009)

Natalie Huet conducted a technical and a compositional study on a series of beads from the Brunei wreck and made some critical observations.[524] While many of the beads found were similar to those found on the Lena Shoal and the Santa Cruz (the black beads, the drawn yellow and the coiled blue beads), many others were of a previously unknown grey or blackish colour. Huet observed that these samples are reflective of what occurs to glass objects in seawater. Further analysis of these beads showed that their colour had been "washed away" on the outside layers of the beads. This washed layer (~20-30 micrometres thick) highlights the caution needed when identifying glass beads from shipwrecks, especially those samples that have not undergone surface colouring treatment. This is why the beads need to be cut (in the case of SEM analysis) or laser-bored (in the case of LA-ICP-MS) to ascertain an accurate reading of their composition.

5.2.1.1 Rethinking the bead trade in terms of containment/packaging

The technological and compositional studies on bead research are effective and necessary to understand this object type, yet with more accurate record keeping and with full access to the assemblage inventories, it would be possible to observe a more detailed picture of the bead trade in the region. We know which jars held the beads from the Lena Shoal, but we are less sure about the beads from the Santa Cruz. As mentioned previously, a number of beads in one

[523] Phongphanit. 2009, p.173
[524] In L'Hour 2001b.

case were recorded as being from a blue-and-white covered box.[525] The majority of the beads from the Santa Cruz were catalogued separately from their respective jars; we are less sure as to which type of container these beads occupied. For example, there is no correlation between any jar and the inventoried beads (inventory no. 4) in the square (N16W8) from whence they were excavated.

The excavation information on the beads from inventory no. 11921, however, shows promise. These beads were recovered from grid N19W8.[526] Eighteen jars were associated with this grid; five of them were described as the type of jar similar to the jars from the Lena Shoal that contained beads.[527] They were described as "Tall jars, with four ears, brown or black glazed and from the Sawankhalok kilns. Photographic evidence revealed that four of these jars were similar to the Maenam Noi jars from the Lena Shoal.

Other jars excavated from other grid coordinates were described as having concretions of beads on their mouths and/or along their rims. The inventory items that had these concretions are jars that are similarly styled to the Maenam Noi jars associated with the beads from the Lena Shoal wreck, two examples being inventory numbers 232 and 1823 (Fig. 5.12). This is an aspect of cargo lading that needs pursuing. Is the pairing of beads and the jars from Maenam Noi intentional or accidental?



Figure 5. 12: Maenam Noi jars from the Santa Cruz with concreted bead association. (FEFNA)

[525] See footnote 447.
[526] Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996
[527] Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996

It is necessary to investigate other shipwreck assemblages with beads in them to ascertain whether they yield similar information. Cayron reports that the glass beads that he analysed from the Pandanan were found in Vietnamese stoneware jars, however, photographic evidence of the type of jar that he refers to was not available, nor was any more accurate provenance information given.[528] Sixty-three Maenam Noi jars were present on the Pandanan wreck.[529] Which could contribute to the narrative in a few ways. It could be that a misinterpretation was made pertaining to the type of stoneware jar the beads of the Pandanan were found in, and the beads were actually in a Maenam Noi jar from Thailand. However, the Vietnamese stoneware jars and the Thai Maenam Noi jars are not visually similar. It would be difficult to make a mistake like this.

It is more likely that the black and red beads that Cayron analysed from Vietnamese stoneware jars have a difficult chemical makeup from those found in the Maenam Noi jars of the Lena Shoal and the Santa Cruz. This would support the Maenam Noi jar/glass bead hypothesis, but modify the model to reflect beads with differing recipes (either technological or compositional) being transported by a different local ceramic vessel (e.g. black and red beads being connected to Vietnam, and blue/a different type of black bead to Maenam Noi jars). The type and style of the red beads from the Pandanan were not on the Lena Shoal or the Santa Cruz. Given the strong representation of Vietnamese wares on the Pandanan (versus the low representation of these wares on the Lena Shoal and the Santa Cruz), it is probable that they were coming from different ports of call.

By looking at the storage vessels of this object type we also may see trends in large-scale trade and private, individual trade. For example, the separated glass beads in the Maenam Noi jars from the Lena Shoal and the Santa Cruz might reflect a large scale, or merchant trade on the ship, while the mixed beads in the blue-and-white box (from the Santa Cruz) may reflect personal trade or personal property. This type of trade can also be seen with the pepper in the blue-and-white box from the Lena Shoal.[530] Understanding whether the cargo was loaded simply by type or by individual share ratios could help contribute to this line of reasoning. Given their sole appearance on the later shipwrecks in this case study, supported by the research conducted on the Brunei and the Pandanan wrecks either immediately before or in

[528] 2002
[529] Diem 1998
[530] Described in the previous chapter.

the early years of European contact, beads seem to be traded in large quantities from the 15th Century onwards.

A comprehensive analysis of the beads from the Santa Cruz along with a more thorough analysis of the beads from the Lena Shoal would help to correlate the bead material found on the Brunei wreck and with terrestrial sites in Southeast Asia. While this information may not help to confidently trace beads from their production centres via shipwrecks to sites, it will help in allowing us to see potential trade route patterns in the types and quantities of glass beads in the few places that they have been analysed. These hypothesized trade networks can then be tested as further data becomes available.

Glass Bracelets

Thirty-three glass bracelets and ten glass rings were found on the Santa Cruz, all of which were green coloured.[531] The bracelet diameters were identical (6.7± 0.5 cm) and triangular in cross-section (Fig. 5.13).



Figure 5. 13: Glass bracelet from the Santa Cruz. (FEFNA)

The bracelets found on the Brunei wreck are descriptively similar to those found in the Santa Cruz assemblage. The analysed bracelets from the Brunei wreck have a high alumina content (6 %) along with a high percentage of sodium (>20 %). The green colour is obtained by the naturally occurring iron in the material, and intensified by adding copper to the recipe.[532] The likely aim for merchants and artisans for these pieces of jewellery was to closely emulate jade. These items have also been located in Chaya and Bang Kluay.[533] Phongphanit suggests

[531] Yellow, blue and green glass bracelets were found on the Brunei wreck.
[532] L'Hour 2001b, p.130
[533] Phongphanit. 2009

that the glass waste and the bead breakage found at those sites reflect possible glass workshops in the region.[534]

5.2.2 Stone Material

Usually the majority of stone recovered from shipwrecks can be associated with ballast material. Ballast can be stone collected during some portion of a voyage, or being used as a trade good to barter as building material in the region.[535] It is quite typical that stone material that is associated with a shipwreck tends to have concretions on them, or, depending upon the depth of the finds, be relatively smooth due to wave action.[536] Stone from maritime contexts can be worn smooth if deposited in a high-energy environment, or else may become concreted in marine encrustation in lower energy environments.

Marble

Fifteen pieces of marble were found in the case study and all from the Lena Shoal wreck; one cylinder, three unidentified perforated objects, and eleven "discs" (Figs. 5.14, 5.15, 5.16).

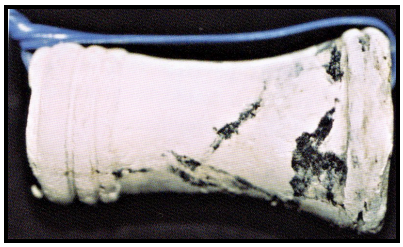


Figure 5. 14: Marble "bead"? from the Lena Shoal. (Goddio, 2002, pg. 255)

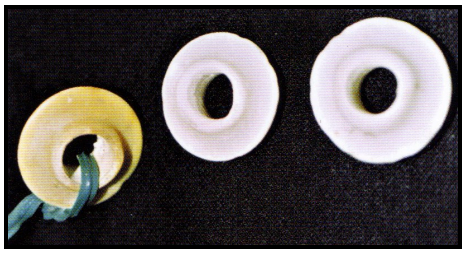


Figure 5. 15: Marble "beads"? from the Lena Shoal. (Goddio, 2002, pg. 255)



Figure 5. 16: Marble disc from the Lena Shoal. (Goddio, 2002, pg. 253)

[534] Phongphanit. 2009
[535] Green 1973; Macleod 1981
[536] Pearson 1987, p.267

It is not known how this material how this material was analysed and subsequently identified as marble. Goddio did mention the difficulty of correctly differentiating between shell and marble discs. [537]

Sourcing this material is problematic. Marble quarries presently exist in China, Vietnam, Thailand, East Timor and the Philippines. The provenance of the material can be analysed through petrographical, geochemical, trace element and stable-isotope analysis and spectroscopic means, yet it is necessary to obtain specimen samples from the various sources throughout the region in order to source the artefacts in question.[538] It is also quite possible that the provenance of these artefacts come from quarries that either have not been found or have been completely mined out.

This also would not identify where these pieces were actually fabricated. Similar objects have not been found in either terrestrial or maritime excavations in Southeast Asia, which could suggest a source beyond the region, but the evidence for this is scant. If the original inventory of Lena Shoal were made available, it might be possible to associate the material with either the trade goods on the ship, or personal items. The marble discs appear to be similar in shape and diameter to the shell discs found on the Lena Shoal, possibly suggesting that they could also be used as counters or tokens in a game. [539]

Ballast stones

We have little archaeological evidence in the way of ballast stones from shipwreck assemblages in Southeast Asia. It is likely that within the wrecks in this case study that the cargo was the ballast. There is an isolated case of ships ballast in the archaeological record from the Java Sea wreck, dating to the thirteenth century.[540] Otherwise, all of the other ballast artefacts are dated to after the sixteenth century. The Ko Kradat (1522-1566CE) wreck is the only South China Sea hybrid ship with a substantial amount of stone ballast.[541] It is also conceivable that shipwrecks that were partially or fully loaded with stone ballast have either not been identified or discovered. Consequently, ships with stone ballast may well be largely missing from the archaeological record, because a pile of rocks underwater can easily be

[537] Goddio et al. 2002
[538] Herz 1985; Herz et al. 1988; Margolis & Showers 1988; Moens et al. 1988; Grimanis & Vasseliki-Grimani 1988
[539] See Chapter 4 on the Shell material found in this case study.
[540] Flecker 2003
[541] Howitz 1979

overlooked. Archaeologists excavating the San Isidro (1550-1580 CE), and the Griffin (1761 CE) have identified ballast in the inventories, but these ships are European, and the ballast is in the form of iron ingots.[542]

In the wrecks of this study, only two ships have reported ballast stones: five ballast stones were part of the assemblage of the Lena Shoal, and the inventory of the Santa Cruz accounts for two ballast stones.[543] These amounts do not seem to be enough weight to make a substantial difference in the secure sailing of the ship. Similar stones could have been left at these sites (and others in the region) because it is difficult to distinguish natural stone with ballast stones. In that case these stones could be a representative sample of a much larger assemblage. Worked stone obviously stands out more than raw stone as an artefact. The ballast stones that have been recovered could have been associated with existing artefacts or found within the hulls themselves. There is no context information to account for their location in either wreck.

Unfortunately, the type of stone for each ballast stone was not recorded and it is obviously impossible to geologically source generic 'stone'. Here we face the same problem as was identified with the marble objects, without accurate analysis provenance studies are impossible. If we could source the material, there is an array of study that could be gleaned from such information. Looking at the stones contextually, an in-depth analysis could discern whether the material was taken on following the drop-off of the cargo or if it was possibly taken aboard at a homeport. The stone would need to be from a specific source in the region from where the majority of the crew-use pottery came from.[544] An example of this type of analysis was conducted on the Avondster (1659),[545] the Hercules (1661)[546] and the Risdam (1727).[547] These ships all contained a large amount of a yellow brick, famously manufactured in the Netherlands. These bricks were considered ballast (soon to be used as construction materials in Southeast Asia). The presence and known provenance of these bricks aided to the conclusions that these wrecks were all Dutch VOC wrecks.

[542] Goddio & Jay 1988; Orillaneda 2014b
[543] Goddio et al. 2002, p.255; Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996
[544] For example, The Uluburun's cargo Pulak 2001, was analysed in a similar fashion although they use the sources of the stone from the anchors.
[545] Parthesius et al. 2005
[546] Harpster 2013
[547] Green 1986

The identification of the stones in the case study may not be as simple as in the Avondster, but the analysis would certainly give us a step forward in learning more about an individual shipwreck.

Grinding Querns and Rolling Pins/ Sharpening Stones/Inkstones

In the shipwrecks considered in this thesis, low-numbered counts of grinding stones and querns would tend to suggest that they are not items of trade and more for the use of the crew on the voyage. Larger counts would qualify groups of objects as a trade item.

Grinding stones and querns are equipment for food preparation and are for the dietary needs of the people on board the ship. We see this in the single quern from the Lena Shoal (Fig. 5.17) and the three querns from the Santa Cruz (one example is shown in Fig 5.18). The wrecks of the Turiang, the Rang Kwien and the Ko Si Chang III did not yield any querns or pins. A lack of such objects on these ships could be that they simply did feel the need to process grain or vegetal material on board. This may be a reflection of the shipping routes of these vessels, making them more local traders rather than long distance ships. It is also more likely that these items were either not found during the excavations or found, yet not recovered.

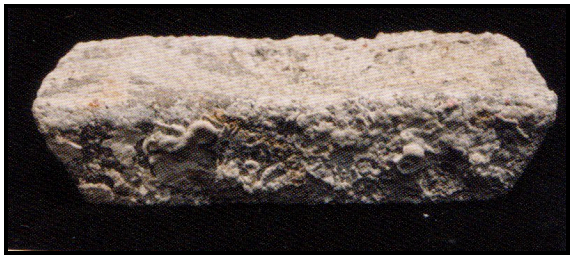


Figure 5. 17: Quern from the Lena Shoal. (Goddio, 2002, pg. 255)



Figure 5. 18: Quern from the Santa Cruz. (FEFNA)

The quern from the Lena Shoal shows use, with wear on the top surface, through the action of a grinding pin. The sixteen querns with rolling pins from the Bakau wreck (Fig. 5.19) would tend to suggest that sets were also shipped as items of trade.

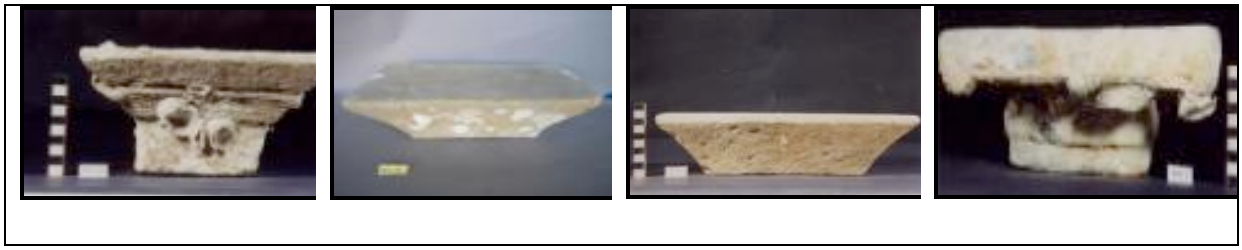


Figure 5. 19: Some of the stone querns from the Bakau wreck. (Experiential Museum)

The querns from the Bakau have all been described as "anvil" shaped querns,[548] due to their small stone bases that outwardly angle to a large platform for use in grinding vegetable matter. These were unused and found within the cargo hold, indicated that they are most likely a trade good; the first instance that grinding stones are being traded throughout the region.

I would suggest that quern stones are a significant find, and worth studying in greater detail. The bulk of the scholarship on querns in Southeast Asia has been done on pre-historic examples in mainland Southeast Asia[549] and India.[550] More recent studies on the subject highlight an excavation in Petchaburi Province dating to the Dvaravati period was conducted in 2001. The remains of a workshop found there produced stone saddle querns (Fig. 5.20), rollers, and milling stones was found about 100 kilometres north of Bangkok. Geologists identified stones from the site that pertain to the utensils as being green sandstone and andesite. [551]



Figure 5. 20: "Saddle" quern from Petchaburi Province. (Indrawooth, 2006)

[548] Liow 2013; Flecker 2001b
[549] Higham 1989, p.272
[550] Sankalia & Deo 2011; Imam et al. 2006
[551] Indrawooth 2006

Obviously, we have the same issues about sourcing this stone material as previously mentioned with regard to the ballast stones. We can perform a compositional analysis, but would need reliable comparative sourcing data to determine where the stone is coming from. While sourcing the stone does not automatically confirm that the stone was being worked where the material was mined, I would argue that due to the weight of the stone, shaping them at the source was preferable to moving large blocks of unworked stone. This is commonly done with stone cargoes in the Mediterranean.[552] The querns can also be analysed and compared to other stone material found within the assemblage (like the ballast stones or sharpening stones), or other stone querns in other shipwrecks. Twenty-one grinding stones with pins have been recovered from the Pandanan wreck (1450-1487) in the Philippines. This suggests a relatively common pattern of trade. Most of the Pandanan's cargo was from Vietnam. The grinding stones could be from the same region as the ceramics. A comparative analysis of the grinding stones from the Bakau would contribute greatly to the scholarship of the medium.

There are noticeable morphological differences between the quern from the Lena Shoal, one of the querns from the Santa Cruz and all of the querns from the Bakau. The sides of the quern from the Lena Shoal (Fig. 5.17) are less tapered than the sides on the querns from the Bakau. While one of the querns from the Santa Cruz resemble those on the Bakau (Fig. 5.21), the other quern from the Santa Cruz (Fig. 5.18) has no tapering sides and its platform is angled slightly. The angled platform from the quern on the Santa Cruz could be a symptom of constant usage. Closer inspection would need to be conducted to ascertain such a condition.



Figure 5. 21: Trapezoidal quern from the Santa Cruz. (FEFNA)

[552] Russell 2013, p.261

Although all of the querns from the Bakau were identified as “anvil querns”, I would suggest that there are two general shapes of the querns from the Bakau wreck. One is a geometrically trapezoidal shape, like the quern from the Lena Shoal but with greater flared sides (Fig. 5.22). The other shape resembles the “saddle” or “anvil” shaped type, like the one from Petchaburi Province (Fig. 5.23).



Figure 5. 22: Trapezoidal shaped querns from the Bakau wreck. (Experiential Museum)



Figure 5. 23: "Saddle shaped” querns from the Bakau wreck. (Experiential Museum)

Again, a compositional study of the querns from the Bakau would reveal if they were all made from the same type of stone from the same geological location. This information can help us answer questions as to stone type and style design (e.g. different shaped grinding stones are from different production centres), or stone type and grinding function (e.g. one type of stone is used to grind vegetal matter, while a different type of stone is used to grind grains). It could also reveal stylistic trends. Only a more in depth analysis of querns as a whole could answer these questions. This has not yet been done for terrestrial sites and a comprehensive look at this material would add to the breadth of knowledge of these items.

The round grinding stones (rotary querns) found amongst the shipwreck assemblages of the study group are associated with the grinding of grains.[553] Nine single grinding stones and one double grinding stone were recovered from the Bakau. I believe that the difference between a single grinding stone and a double grinding stone in the archaeological reports has to do with recovery context. In the Bakau inventory, some of the grinding stones are solid (Fig. 5.24),

[553] The querns are likely used for grinding vegetal material.

while others have a hole in the centre (Fig. 5.25). It suggests that the grinding stones were recovered separately and given individual accession numbers, but have never been paired up to reform the standard grinding stone.[554] Since these objects would be paired for usage, the fact that an odd number of these were recovered suggests that all of them were not recovered or that these are simply an indicator of ships ballast.

Mapping a geographical distribution of these two types of grinding stones in the region would be a line of interesting research.

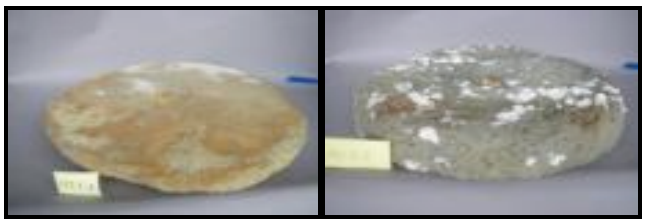


Figure 5. 24: Single, no hole grinding stones from the Bakau. (Experiential Museum)

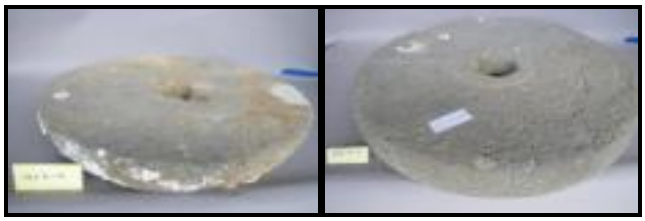


Figure 5. 25: Single, centre holed grinding stones from the Bakau. (Experiential Museum)

It should be noted that rotary querns are only found on one shipwreck in this case study, and have also not been found in any other shipwreck assemblage in Southeast Asia. They appear not to be a widespread item of maritime trade nor commonly used on board ship by their crews. This would suggest that if the ship carried any grains for cooking, it was normally purchased already prepared, or else the grains were milled on the same querns that were used to grind the vegetal material.

[554] A complete grain grinding stone apparatus would consist of two circular grinding "wheels" one solid and one with a whole in the centre. The wheel with the hole would rest on op of the solid wheel. Grain is then poured into the hole and the top wheel is turned to grind the grain. The milled grain then spills out of the sides of the wheel ready to be used for cooking.

Goddio mentions one sharpening stone found on the Lena Shoal (Fig. 5.26).[555] Its surface does indeed appear to be well worn. Given that its shape is different to the grinding stone on the ship, I agree that this type of stone performed a different task than the quern. A sharpening stone is as likely a theory as any. The sharpening stone identified on the Turiang, however (Fig. 5.27), shares no shape or wear characteristics with the sharpening stone from the Lena Shoal.[556] This suggests that there are no definitive typological characteristics that qualify an object as a 'sharpening stone'. The one similar characteristic that the sharpening stones from the Turiang and the Lena Shoal share is that they both have a smooth surface. In the case of the Turiang's stone, its smoothness could be explained away due to wave action and weathering. The Lena Shoal sharpening stone is only smooth on one side suggesting that the item had a function, and was used for either grinding and/or sharpening.

Three sharpening stones were identified in the assemblage of the Santa Cruz, yet no photographic evidence could be presented.[557] Whetstones would be a common find on ships given the need to keep tools and weapons sharp. These artefacts were probably a crew use item, rather than a trade good.

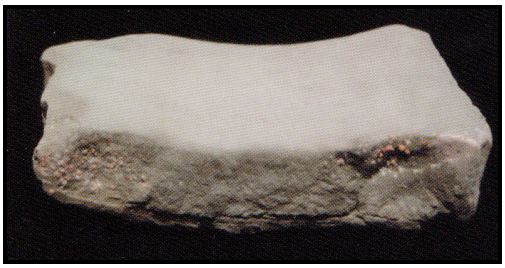


Figure 5. 26: Sharpening stone from the Lena Shoal. (Goddio, 2002, pg. 255)



Figure 5. 27: Sharpening stone from the Turiang. (Brown, 2000, pg. 39)

Two ink stones were identified in the assemblages of this case study; one from the Bakau (Fig 5.28), and one from the Santa Cruz (Fig 5.29).

[555] Goddio et al. 2002, p.255
[556] Brown & Sjostrand 2000, p.39
[557] Orillaneda 2013



Figure 5. 28: Inkstone from the Bakau wreck.
(Experiential Museum, Singapore)



Figure 5. 29: Inkstone from the Santa Cruz. (FEFNA)

A defining characteristic of an inkstone would be a recess of some type on the stone, where the ink would pool, and not run off the surface of the stone. The Bakau inkstone does not appear to have this recess. It seems more likely that the artefact is a whetstone. The Santa Cruz artifact is more plausable as an inkstone, because there is the feature on the surface where ink can pool. It also appears to be too small to be a grinder or pestle. The inkstone is likely a crew-use item. We would likely encounter more of them onboard if it was a trade good. Also, it is a neccessary tool to use while preparing ink for manifests or other documentation. Its presence proposes a heirarchy on the ship, since using an inkstone would suggest a need for literacy. Discussing what is written about maritime hierarchy and comparing this to the artefactual evidence offers us another interesting line of research.

These research suggestions simply highlight the need for more in depth work on these artefacts, not only to ascertain where these stones are coming from, but exactly how they are being used onboard ship. Given the above examples, clearly a sharpening stone can be interpreted in a number of ways. The stones could be different depending upon the blades that are used to sharpen them (e.g. one could be for sharpening bladed weapons, while the other is used for kitchen blades). The stone from the Turiang could also be a type of holystone, used by sailors to scrub a wooden deck of a ship. If we knew where these were found in relation

to other artefacts on the wrecks then they could reveal clues as to their role on these ships as well.

5.3 Minerals

Sphalerite

Sphalerite, or Zinc Sulphide (ZnS), was only found as part of the cargo of the Turiang (Fig. 5.1). A gemmologist of Kurt Ribbhagen AB, silversmith and antique dealer in Stockholm, identified the material.[558] Sjostrand posits that the mineral, when ground up into a powder, was a form of makeup. There is no detail or references given as to how this was identified as Sphalerite, nor into the reasoning that this was used as a form of cosmetics.

The theory that the sphalerite was used as a form of makeup, however, is dubious. Scholarship on ancient cosmetics is limited. Most of the research surrounding ancient cosmetics pertains largely to the Egyptian, Greek and Roman cultures.[559] I could find only one research paper on the cosmetics of ancient China.[560] None of these sources suggest the use of sphalerite as a form of cosmetic. They all, however, mention the widespread use of galena, or lead sulphide (PbS) as facial makeup. The only reference of sphalerite being used in makeup occurs in modern recipes of cosmetics.[561] In these cases, sphalerite is not used as an eye-catching "glitter", as Sjostrand describes it, but as a depilatory agent.[562] If the material can be re-obtained, then its chemical makeup can be confirmed.[563]

The fact that the mineral was found in ten storage jars is significant.[564] Obviously, it was a valued trade good. While there still is the possibility that the material was used for cosmetic purposes, I believe that another possibility should be considered. Sphalerite was a mineral commonly used in Ayurvedic medicine. Craddocks analysis of Indian Ayurvedic medical texts from the 11th through 14th Centuries highlights the importance of zinc oxides in Ayurvedic treatments.[565] The texts describe the metallurgical process by which zinc sulphide is smelted in large quantities to convert the sulphides into oxides. Craddock deduces that

[558] Brown & Sjostrand 2000, p.39
[559] Welcomme et al. 2006; Manniche 1999; Wiseman 1979; Dayagi-Mendeles & Muzeon Yisrael 1989
[560] Schafer 1956
[561] Haldar 2013, p.27; Hardy et al. 2008
[562] Ash & Ash 2004, p.598
[563] During my fieldwork, I was not able to document the artefacts of the Turiang, housed in the Museum of Malaysia. Therefore, I could not confirm its presence within the assemblage at present.
[564] More sphalerite could have been stored on the Turiang, but quite possibly due to the site conditions, it may have deteriorated.
[565] Craddock 2009

sphalerite is the most likely sulphide used due to the vast deposits found throughout South Asia.

The conversion process from Zinc Sulphide into Zinc Oxide then permits its use in Ayurvedic medicine to treat a number of conditions internally and externally. Zinc Oxide can be used to treat low-level illnesses like common colds and fever; it can be used topically to heal wounds; or treat more substantial conditions like conjunctivitis and trachoma.[566]

As Buddhism spread from India to Southeast Asia, it came with a number of other cultural, technological and theoretical transfers. The spread of Ayurvedic medicine is one of these transfers.[567] The cargo on the Turiang can represent material that was bound for parts of South Asia steeped in Ayurvedic traditions, or part of a local trade in Ayurvedic practice. Given that India has large deposits of Sphalerite, I would suggest that the market value of internationally traded Sphalerite was low; therefore it is likely to have been regionally traded in Southeast Asia. If the samples from the Turiang were analysed and found to be of greater purity than South Asian samples, then the possibility that the sphalerite was bound for South Asia must be more seriously considered.

Brown and Sjostrand mention that there is a substantial source for sphalerite in Bo Sam Kleaw at Phrae Province in Thailand.[568] This, however, is at the northern borders of Thailand, approximately 600km from Samut Sakhon. There was a larger and closer source of the material closer to Ayutthaya, in Thong Pha Phum, Kanchanburi province. [569] This supports the logistical theory of the Sphalerite being loaded into the Suphanburi jars. Since both materials would travel down the Tha Chin River, and eventually end up at Samut Sakhon on the Gulf of Thailand to access the Ayutthayan emporium. The Suphanburi kilns are farther upriver than the Sphalerite quarry; therefore it is conceivable that a local ceramic trade was being conducted at Thong Pha Phum. The storage jars purchased were then loaded with Sphalerite and loaded onto boats headed to Samut Sakhon, to trade locally in Ayutthaya, or with maritime traders headed to other countries.

Red Pigment

[566] Panda & Rout 2006
[567] Leslie 1976, p.3,151,215
[568] 2000, p.39
[569] Angkatavanich 1975, p.68

Seven small lumps of "red pigment" were found in the assemblage of the Bakau wreck (Fig. 5.30).[570] The material was never analysed to discern its chemical makeup. Similar material was found on the Tagbita Bay shipwreck (19th Century British ship)[571] (Fig. 5.31), the Vung Tau shipwreck (Chinese lorcha from the 17th Century),[572] and the Binh Thuan shipwreck (17th Century Dutch VOC shipwreck). [573]

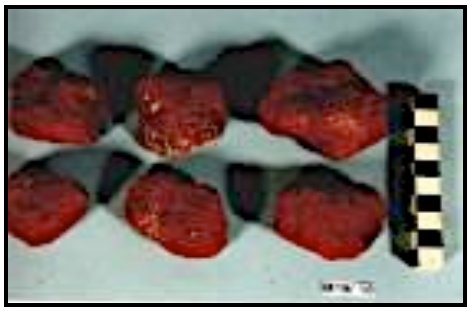


Figure 5. 30: Red pigment from the Bakau wreck. (Experiential Museum, Singapore)



Figure 5. 31: Red pigment from the Tagbita Bay shipwreck. (Bobby Orillaneda, 2015)

The pigment from the Tagbita Bay shipwreck (19th Century British ship) was found in powder form inside a metal box, while the pigment from the Bakau, the Vung Tau and the Binh Thuan were found in ceramic jars and shaped into lumps. This could a condition of how the pigment reacts to an aqueous environment (e.g. the metal box protected the pigment better than the ceramics; therefore it remained in its original state). Another possibility could be that these pigments are different. At present, none of them have been compositionally analysed. The pigment from the Tagbita Bay has been described as "possible sealing wax"; while it is believed that the pigment from the Binh Thuan [574] and the Vung Tau [575] is a type of paint. Only a detailed chemical analysis of this material would assure us that there is a relational connection to the pigment. A study of this material could give us a rich biography of how this was traded between the 14th and 19th centuries. If the pigment on the Bakau is similar to the other wrecks, it reflects the long tradition of trade in the red pigment before European contact

[570] Flecker 2001b
[571] Orillaneda 2015
[572] Flecker 1992b
[573] Flecker 2004
[574] Flecker 2004
[575] Flecker 1992b

in the region. If the materials are not similar it remains an important point of discussion regarding commodities in the Medieval South China Sea trade.

5.3 Discussion

When considering the objects that form the miscellany section of this thesis, we are again confronted by items that occur in the artefactual assemblages of shipwrecks which save for the glass beads — are studied with less rigor than their ceramic counterparts. The fact that beads are the only other objects that are widely studied confirms that the aesthetics of an object plays a large part into the scholarship on that material.

5.3.1 Ship Assemblage Narratives

The Turiang is a Chinese-style boat that contained ceramics from China, Thailand and Vietnam. Thai wares made up the bulk of the ceramic assemblage; nearly one-and-one-half times (57 %) that of the Chinese ceramic material (35 %). Vietnamese wares made up the difference (8 %). Iron in powder form was present, likely from the iron sand beaches of Sumatra or Java. Organic material from the Turiang consisted of foodstuffs in the form of eggs likely from mainland Southeast Asia, and fish from the Gulf of Thailand. Ivory was also part of the cargo as a trade good, also from mainland Southeast Asia. Mineral material was found on the Turiang in the form of Sphalerite, likely coming from mainland Southeast Asia, to be used in Ayurvedic treatments and practices in regional communities (Fig. 5.32).

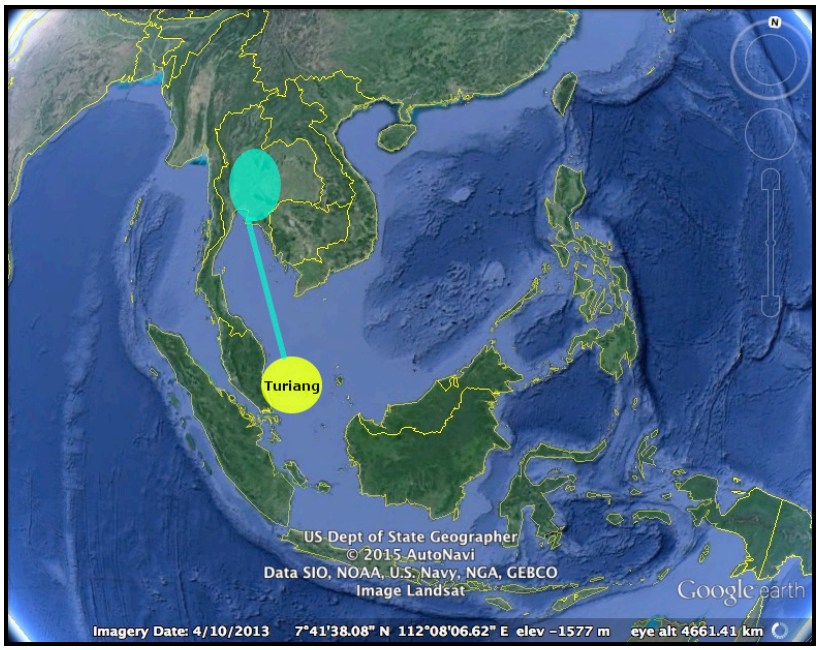


Figure 5. 32: Network of stone and mineral material from the Turiang. (Google Earth, additions, B.Fahy)

The Bakau is a Chinese-style boat that contained ceramics from China, Thailand and Vietnam. Thai wares make up the bulk of the ceramic assemblage (67 %), over double that of the Chinese ceramic material (32 %). Vietnamese wares make up the lowest proportion (1 %). Tin ingots from Malaysia were present in the assemblage, as well as bronze mirrors and tweezers, gongs and coins from China. Iron pots found on board were also manufactured in China. Some metal items like fishhooks, scale chains and weights, and fish, net, and sounding weights, while they cannot be attributed as coming from any specific region, gives clues into life on board. Star anise has been identified as part of the organic assemblage as well as lacquer ware boxes: both from China. Animal bones were also part of the assemblage, likely from mainland Southeast Asia. Mineral material was found on the Bakau in the form of red pigment. A large amount of stone was also on the Bakau, likely coming from mainland Southeast Asia (Fig 5.33) which reveals a regional trade in this type of product.

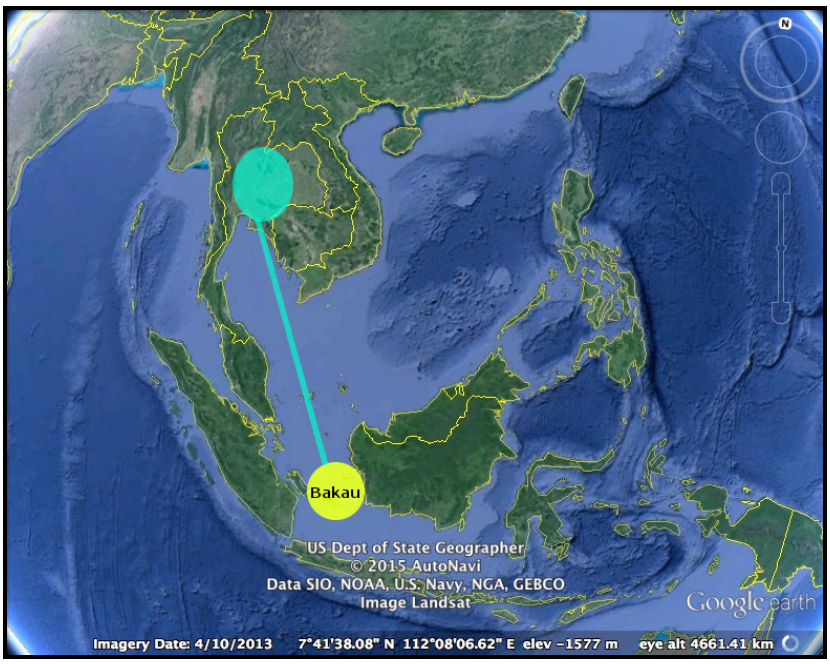


Figure 5. 33: Network of stone and mineral material from the Bakau. (Google Earth, additions, B. Fahy)

The Rang Kwien is either a Japanese or Chinese-style junk that contained ceramics from China, Thailand and Vietnam. Thai wares make up the bulk of the ceramic assemblage (75 %) with over four times as much material as Vietnamese wares (18 %). Chinese ceramics make up the lowest identified portion (3 %). Lead and copper ingots were also part of the assemblage, raw materials likely sourced from Thailand. Chinese items include thousands of minted coins, iron pots, a bronze mirror and a bronze gong. A tsuba from Japan was also recovered. Finery was found on board in the form of jewelled earrings, revealing some of the wealth that travelled through the region. Organic material from the Rang Kwien consisted of

foodstuffs found throughout Southeast Asia. Areca nuts and eggs from mainland and archipelagic Southeast Asia were present, as well as mangrove crabs from the coasts of the Gulf of Thailand and South China Sea. No stone or mineral material was recovered from the Rang Kwien (Fig. 5.34).

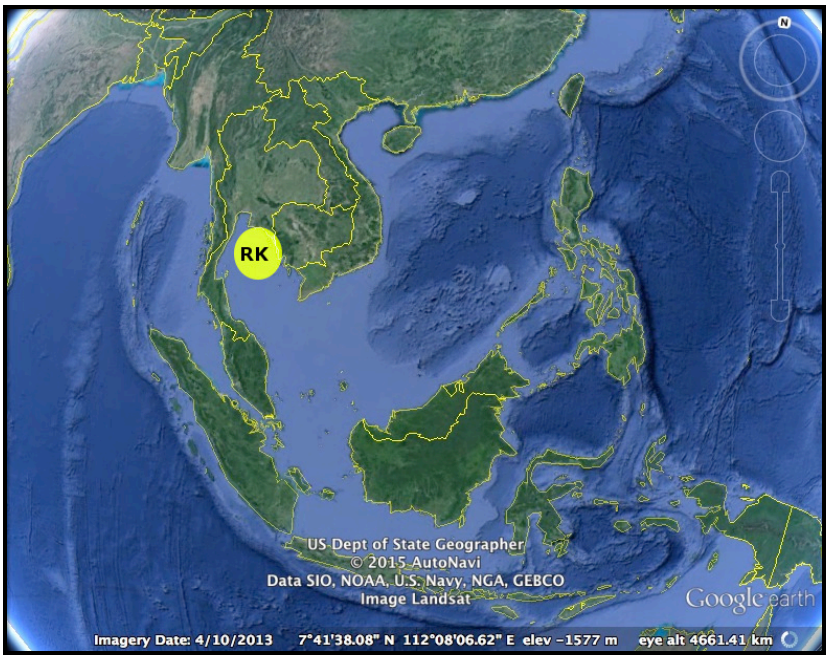


Figure 5. 34: Network of stone and mineral material from the Rang Kwien. (Google Earth, additions, B.Fahy)

The Ko Si Chang III is a Southeast Asian-style junk that contained ceramics from China, Thailand and Vietnam. Thai wares make up most of the ceramic assemblage (95 %). Very few Chinese (1 %) and Vietnamese (1 %) ceramics are part of the assemblage. Lead and copper ingots were part of the assemblage, likely mined in Thailand. Bronze lime containers likely manufactured in peninsular Southeast Asia was found on board as well. Organic material on the Ko Si Chang III consisted of foodstuffs in the form of eggs from mainland Southeast Asia, and Areca nut from all over Southeast Asia and the Indian Ocean. Identified organic commodities from the Ko Si Chang III consisted exclusively of ivory from mainland Southeast Asia. No stone or mineral material was recovered from the Ko Si Chang III (Fig. 5.35).

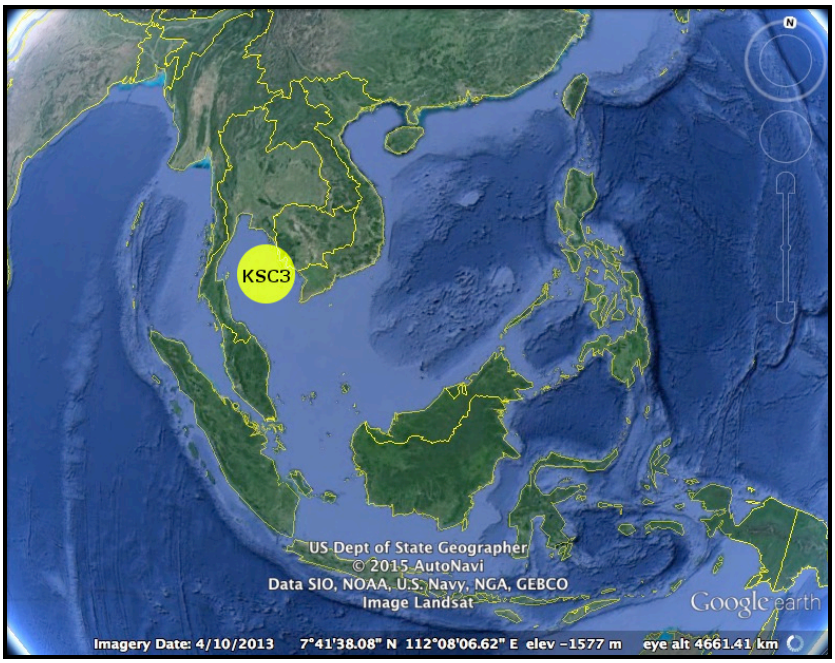


Figure 5. 35: Network of stone and mineral material from the Ko Si Chang III. (Google Earth, additions, B.Fahy)

The Lena Shoal is a Southeast Asian-style junk that contained ceramics from China, Thailand, Vietnam, and Burma. Chinese wares make up the bulk of the ceramic assemblage (71 %), its proportional makeup is over three times larger than its next largest ceramic type (Thai, 23 %). Burmese wares (3 %) and Vietnamese wares (1 %) round out the proportional representation. Tin ingots from Malaysia were part of the assemblage. A large amount of brass bracelets, likely manufactured in Peninsular Southeast Asia, was also present. Chinese material included bronze cannons, gongs and coins, as well as iron pots and needles. Organic material consisted of pepper from either India or Sumatra, ivory from mainland Southeast Asia and lacquer ware from China. Other organic material found in the assemblage, while could not be attributed to a specific area, could give us insight into cargo handling (palm leaves and bamboo fibres) and social interaction on the boat in the form of games (shell discs). Glass beads from China and mainland Southeast Asia were also present in the assemblage of the Lena Shoal (Fig. 5.36). The ship was also ballasted with stones, although there is no indication where these come from. Stone querns and rollers in the assemblage offer us insight into food preparation on board.

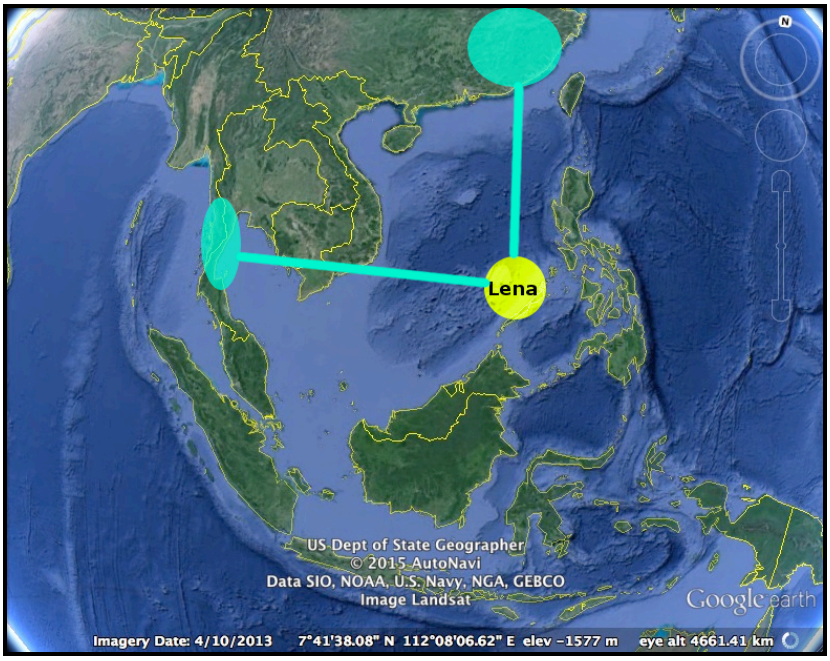


Figure 5. 36: Network of stone and glass material from the Lena Shoal. (Google Earth, additions, B.Fahy)

The Santa Cruz is a Southeast Asian-style junk that contained ceramics from China, Thailand, Vietnam and Burma. Chinese wares make up the bulk of the ceramic assemblage (86 %), with Thai (9 %), Burmese (3 %), and Vietnamese (1 %) rounding out the rest of the representational proportion. Tin ingots from Malaysia were part of the assemblage. A large amount of brass bracelets, likely manufactured in Peninsular Southeast Asia, was also present. Chinese material included bronze cannons and gongs, as well as iron pots. Identifiable organics from the Santa Cruz are in the form of lacquer ware, manufactured in China. Glass beads from China and mainland Southeast Asia were also part of the Santa Cruz assemblage (Fig 5.37). Stone material, though not able to be sourced, give us a glimpse into food preparation (in the form of a quern and a rolling pin), and usage of the written word on board (in the form of an inkstone).

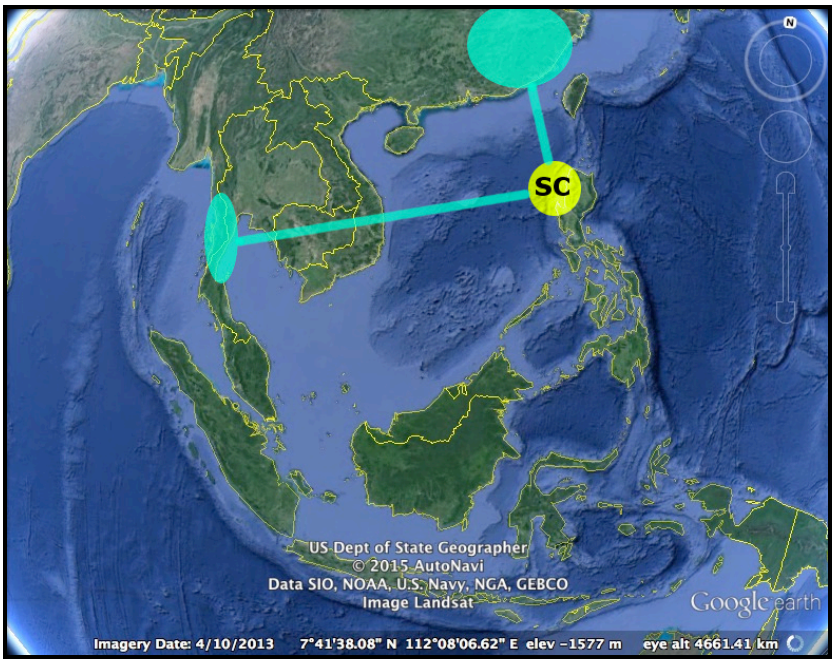


Figure 5. 37: Network of stone and glass material from the Santa Cruz. (Google Earth, additions, B.Fahy)

The idea that ceramics deserve more attention and more analysis because they survive better in this environment falls away in this chapter. In a maritime environment, objects made of dense stone survive better than ceramics and glass. There may not be the same volume of stone artefacts compared with ceramic material, but stone is a more durable substance and should prompt a more detailed study of this type of material.

It is true that only one shipwreck in the case study (the Bakau) is likely to have been trading in stone querns and rollers, but that is important in its own right. Over two-thirds of the Bakau's ceramic cargo was made up of Thai wares (67%). This information, paired with the quern workshop in Petchaburi Province could suggest that the grinding stones are also coming from Thailand.[576] The material could certainly function as a type of saleable ballast. Judging by other unique artefacts in the assemblages in the case study (i.e. pigment, bronze mirrors and tweezers, star anise), this ship could be trading with different consumers and in different markets than others in the sample group. It could have specifically docked in more local markets, as opposed to a typical ocean going trader. The lack of querns in other assemblages could also mean that it is not widely traded or are not as profitable in certain markets. It could also be a normal commodity that we simply have not seen on wrecks far enough in their travels.

[576] Indrawooth 2006

The functionality of the stones found on these ships are varied. Besides those querns, grinding stones, and rolling pins, which appear to be items loaded for trade, there are other stone objects found in these assemblages that reveal aspects of shipping life. Sharpening stones recovered from the Lena Shoal and the Turiang speak toward items of utility and function in a ship. Inkstones found on the Bakau and the Santa Cruz promote concepts of literacy, art, bookkeeping and correspondence on board ships during this period. It nurtures premises of role specialization and heiraracy on these ships.

It is also important to stress the connection between resource and container. As mentioned in Chapter 5, there is an interesting array of resources being shuttled throughout the region, many of which did not survive the burial environment to enter into the archaeological record. Ten jars found of Sphalerite were recovered from the Turiang. Seven jars of beads were recovered from the Lena Shoal. It is likely that there were more jars of this material in these assemblages, along with other material that has washed away or degraded.

The empty jars obviously carried something in them. They share a biography; a story that can be interpreted. In that light, should they be disconnected from each other when discussing their shared narrative? The resource's connection to the container is an important relationship that requires better research. It could be a simple geographic convenience like the sphalerite and the Suphanburi jars trading along the same river, or one of functionality, like smaller ceramics inside larger jars for added protection and ease of containment.

This chapter should also be a cautionary tale to those inventorying future shipwreck artefacts. Accessioning material is an important aspect of record keeping in the archaeological process of destroying a site. The interpretation of artefacts is only as good as the report from which they were interpreted.

6.0 Conclusions

"Of course, the next generation can pass its academic existence in endless cataloguing, completing reports on objects excavated during the glory days of the archaeological fathers. It can ransack storerooms for new empirical studies and produce detailed, descriptive reports on works of art that mysteriously appear in museums. This, however, hardly seems like an appropriate use of bright youth." - Stephen Dyson[577]

I can appreciate Dyson's position as he describes how the discipline of archaeology employs its new researchers. He is concerned that young archaeologists do not get enough "trowel time" when they are required to conduct museum research or enter data into databases. The comment is a slight on the state of scholarship and opportunity in archaeology. Optimistically, I would suggest that producing new empirical studies from the records of previous excavations are proof of the dynamism of the discipline. Archaeology is a field that is constantly reinventing itself, developing new theory to answer increasingly more complex questions largely based on artefactual research.

This optimism is what I hope to have brought into this case study. No excavation or publication is perfect. While we can yearn for an ideal "golden standard" of excavation and data analysis, it is unrealistic to expect it every time. For the youth that "ransacks storerooms for new empirical studies", we cannot ask the question, "Why this research was initially conducted in such a manner?" a better question to ask is, "What can we deduce with the information that we have?" This line of questioning brings a sense of optimism to the discipline because it supports reanalysis of the data without judging the previous excavations, and breathes new life into dated themes.

In this thesis, I set out to show how much more nuanced and diverse maritime trade was in 14th and 15th Century Southeast Asia than is currently believed based upon ceramics alone. The rubric of ceramic study is well researched, well documented and employed heavily to describe trading practices during this time period in Southeast Asia. It is understandable that stylistic studies of ceramics are common, because ceramics themselves are common artefacts encountered in the archaeological record, and easy indicators of origin and dissemination.[578] Stylistic differences helped Brown pair Thai ceramic designs to certain kiln sites, and

[577] 1993
[578] Horejs et al. 2010, p.17

attribute an increase in manufacture and consumption of the style to the ban on external trade in the early Ming Dynasty.[579] She also used the shipwrecks to highlight when a re-introduction of large-scale Chinese porcelain trade begins.[580] Yet, as this thesis shows, there is so much more to maritime trade than ceramics and a great deal more to understanding seafaring than looking at one – albeit large – class of artefacts.

A holistic approach is a logical and necessary step in the development of studying shipwreck cargoes and understanding trade patterns, to better see the complex network of trade products and their prospective routes. The approach reveals the interconnectivity of people, objects and places. It then can further support the relatable inferences of cultural, technological, and ideological transfers. As archaeologists, we could either develop a new rubric to study other materials, or integrate them within the existing rubric of ceramic study. It is easier and more applicable to fold the study of other materials into the existing ceramic rubric, because is forces us to relate more directly with the ceramic material.

6.1 What have we learned?

When we look back at the initial body of work that was produced on these shipwrecks, there were large gains made to academic research. However, now that we have the opportunity to reassess the assemblages, have a larger working historical knowledge of Southeast Asian territories, and more archaeological material to cross reference, we can identify gaps in the scholarship that need addressing. Taking each wreck in turn, let us discuss the previous work conducted on the wreck and consider what this thesis contributes to the literature, and by proxy, contributes to the network narrative of each ship.

Much of the research on these wrecks have been largely focussed on the ceramic portions of these assemblages. This is a valid network theory, yet short-sighted in its scope. There are many more relationships that we can extract from the larger assemblage as a whole to connect it better to the general ceramic trade on the region and the nuanced empires that provide this trade in ceramics, as well as the regions that provide resources which are not ceramic based. The ceramic narrative is also largely focused on regional and interregional trade wares. The thesis corrects this notion, by showing how nuanced it is, because we learn more about the people who were trading, how thay are possibly eating, working, and

[579] Brown 2009, pp.69–70
[580] 2009, pp.69–74

defending their ships. The personal aspect of the 'sailor' has been missing from the narrative; a voice that we are trying to bring back to life to tell their story.

Turiang (1370 CE-1400 CE):

The Turiang is a Chinese built ship, measuring 26 metres long and approximately 7-8 metres wide.[581] The interpretation of its assemblage largely surrounded the Thai, Vietnamese and Chinese ceramics. While this is not the entirety of the assemblage there is merit in Brown and Sjostrand's work. These are scholars who do not subscribe to a Sino-centric view on Southeast Asian trade patterns. Their deduction is that Southeast Asian ceramic centres have a strong identity and had an existing and long established network of trade before the long distance trade patterns between the Far East and the Indian Ocean appear. Unfortunately, however correct these interpretations were, they were founded largely on the ceramics in the Turiang's assemblage. Little analysis was conducted and into the non-ceramic material found in the archaeological record of the shipwreck.

There is not enough evidence for Brown and Sjostrand to deduce that the iron granules are coming from China.[582] There is a lack of interpretation on the fishbones and eggs, which reflects a missed opportunity for them to discuss ideas about crew provisioning. The sphalerite was interpreted as an ingredient for cosmetics, but that was not historically accurate.[583]

Given the Turiang's proximity to iron sand deposits in Sumatra and Malaysia, and the fact that it was loaded on top of Thai ceramics in the hold, it should offer a plausible hypothesis into where the iron granules were coming from, where it was going and its intended usage. Due to the quantity of fish bones found in the assemblage, it raises the theory about the fish sauce trade, and presents ways in which we could use foodstuffs to interpret sailing times between ports of call. The presence of the sphalerite, gives way for a theory into the trade in Ayurvedic medicine.

Rang Kwien (1400 CE- 1430 CE)

[581] Brown 2009, p.172
[582] Brown & Sjostrand 2000, p.14
[583] Brown & Sjostrand 2000, p.39

The Rang Kwien was assumed to be a Chinese boat, measuring 25-30 metres long. [584] The published material is largely based on listing the artefacts within its assemblage. This is a perfect example of a shipwreck needing a larger body of work written on it. This shipwreck is so unique so far as to the amount of coins and jewellery that it was carrying, and gives us an interesting insight into the wealth that is being invested in the region. The uniqueness of the shipwreck merits a book on its own. While Intakosai details the items in the assemblage, there is little in the way of interpretation into what this ship was doing and what it reflected in terms of trading networks.[585]

Again, foodstuffs are mentioned, but no deeper analysis was conducted into crew provisioning. There is a discussion in the published material about where the crew slept, that the ship showed evidence of ships being built to stow cargoes below deck, and that there was a designated space for livestock to be used as a food supply, but no archaeological or illustrative evidence was given for these assumptions. Brown claimed that due to the Japanese copper and the sword guard found on the ship that it may have come from Japan. No reference is cited as to how and where that analysis was deduced from.[586]

Through the assemblage analysis of the Rang Kwien, it presents us with new evidence into the concepts of high value trade, and promotes analysis into the different roles on board a ship. The small hammer could reflect the skill specialization of an artist, jeweller, or a hobbyist on board the ship. The presence of the Japanese tsuba, along with the thousands of coins and jeweller may place bodyguards or mercenaries on board as designated roles associated with these objects.

Bakau (1410 CE-1430 CE)

The Bakau was a Chinese ship measuring 30 metres long by 6.5 metres wide. [587] The one published work on this wreck highlighted its existence and gave us some artefactual context, yet is was mostly focussed on the ceramic cargo. No exact counts were provided, and no opportunity was taken to analyse the organic remains.[588] Flecker believes that the ship is from China, and did not stopover in Vietnam due to the low ceramic counts of Vietnamese wares

[584] Brown 2009, p.172
[585] Intakosai 1983
[586] Brown 2009, p.31
[587] Brown 2009, p.172
[588] Flecker 2001b

in the assemblage. It did travel to a port in Ayutthaya, but this hypothesis put forth was based solely on the ceramics found within the assemblage.

He missed the opportunity to talk about the stone trade through the querns and the grinding stones that were present in the cargo. He missed the opportunity to talk about armaments and outfitting (the cannons and spearpoint). He omitted discussing the organics like star anise, bird bones and pig bones. The mention and interpretation about the raw and worked metals was fleeting as well. There was an opportunity to use these objects to go into further detail about the manufacture and trade network of these non-ceramic objects.

Flecker also missed a large opportunity to discuss shipboard life. There was no mention of the net weights, line weights and fishhooks found in the assemblage. What is most egregious regarding the scholarship on this wreck is that there is no archaeological reports, no excavation notes, and no diagrams. The archaeological context of this wreck has been lost because this shipwreck was treasure hunted. It seems that there is no regard for context when income is a major motive of excavation. Walterfang may claim that selling the whole assemblage to one owner is morally a step closer to heritage protection than a treasure hunted wreck that was auctioned, but cultural heritage protection and academic rigor cannot be done in half measures.[589] It would be more beneficial to local countries and the academic world to let it remain in situ than lose archaeological context, and the heritage that goes away from selling artefacts to the highest bidder, whether all in one group, or in several thousand. The ratification of the UNESCO convention on Underwater Cultural Heritage would help protect these sites and give less legal room for treasure hunters to make a case for recovery.

To correct the artefact oversights of the Bakau, it was necessary to learn more about the non-ceramic items to put them in better context with the ceramic material. That involved giving deeper archaeological detail on known stone manufacturing sites in Southeast Asia and having the organic material analysed. It has been identified as Star Anise by Dr Cristina Castillo of the University College London. This is a significant find because it represents only the second source of proof in the star anise trade, the first being the 9th Century Beilitung shipwreck.[590] This reinforces the concept of a spice trade from China.

Higher analytical concepts can be proposed into the trade of the metal worked items on this ship. There is a larger connection between the bronze mirrors and tweezers in the assemblage,

[589] Walterfang n.d.
[590] Flecker 2001a; Krahl et al. 2010

and its meaning is larger than that of a simple trade good. We are witnessing a trade in goods as well as ideas and concepts of formality, hygiene and beauty. This shipwreck also reflects the first appearance of tin ingots in a shipwreck context, possibly representing a burgeoning raw metals trade.

Ko Si Chang III (1460 CE-1487 CE)

The Ko SI Chang III represents the smallest ship in this case study measuring 20-24m long, and 6m wide. [591] It is a Southeast Asian built ship. The level of academic rigor during the excavated was carried out to a high standard. In the end, the published work is more of an archaeological report designed to itemize the assemblage.[592] A general theory into the trade route of the boat was deduced. The process of publication is an ideal first step in analysis. Detail was given to the artefacts themselves and published, mostly to make the material available for citation and research. Any higher analytical deductions can be interpreted at a later date. The article on the Rang Kwien and the Bakau likely attempted to do a similar justice to the respective archaeological material, but were not done to the degree of detail as the Ko SI Chang III publication.

Green deemed that the ship was likely as a coastal trader, due to the high quantity of local ceramics coupled with the foodstuffs found in the assemblage.[593] It is the first occurrence of using the non-ceramic material to supports a small scale trade. In this case, however, no cross comparison was made with material from other shipwrecks. There was cross comparison with ceramic kiln sites, but not with the non-ceramic materials nor with other maritime sites.

Contributions were made to the published material by discussing how some of these objects fit into the wider trade network. The lead ingots on the Ko Si Chang III reflect an increase in the raw metal trade and deserves more analysis into whether their trade footprint stays local or moves outside of mainland Southeast Asia. Possible connections between the areca nuts and the limepots in the assemblage and how these items may contribute to understanding crew life and social actions on board ships was also discussed in greater detail.

Lena Shoal (1490 CE-1505 CE)

[591] Brown 2009, p.173
[592] Green et al. 1987
[593] Green et al. 1987

The Lena Shoal is estimated to be 24 meters long, and built in the Southeast Asian hybrid tradition.[594] The archaeological context was taken into account, and the project was excavated to a professional standard. The artefactual content is safe from sale as well, due to the agreements set out between the National Museum of the Philippines, the HILTI Foundation and FEFNA.[595]

There are many positive contributions that the published work of the Lena Shoal brings to the discipline. There was in-depth ceramic analysis, they noted the non-ceramic material, and they conducted scientific analysis on the glass beads, the tin ingots and the brass bangles. Goddio managed to document the whole assemblage, even though they did not analyse some of the items in detail. However, because of this, most of the assumptions on trade were based on the ceramic material.

While the non-ceramic material was listed, the gaps in their scholarship are overt. The pepper found in the assemblage was not mentioned in the organic material section, nor discussed in great detail. No exact counts of the inventory were given. For anyone to do a proper reanalysis, an inventory count would be beneficial. Theory states that the ship hit China, Annam, then Siam-its major stop was Malacca, or towards destinations for the Muslim Sultanates in the Philippines.[596] The beads are said to be headed to the Philippines or Borneo.[597]

To correct these oversights, the thesis highlighted some of the non-ceramic material in order to raise concepts that support the trade network or highlight other aspects of maritime life in that period. This involved looking at the concept of private trading, given we have small samples of pepper and glass beads in small blue-and-white containers. Glass beads are also in the assemblage in large amounts, therefore we may be looking a difference between a sailor's individual trades versus a large scale trading practice. It was also important to highlight the tin ingots in the assemblage, because it supports the increasing trend of the trade in the raw metals across Southeast Asia.

Santa Cruz (1490 CE-1505 CE):

[594] Brown 2009, p.173
[595] Goddio et al. 2002
[596] Goddio et al. 2002, p.259
[597] Goddio et al. 2002, p.149

The Santa Cruz is unique because the only published material on it is on the ceramics from the assemblage.[598] The whole of the assemblage has yet to be published. As mentioned throughout this thesis, there are benefits and drawbacks to working just with raw data. Firstly, the whole of the assemblage is available to me via the excavation inventory. I can account for every item brought up from the site. However, in this instance, the analysis is only as good as the data, and the initial interpretations of the person who is recording. They have not done any scientific analysis; therefore they are using their best judgement to categorize the artefacts. For example, the trapezoidal ingots on the Santa Cruz were labelled as lead ingots, likely due to the colour of the corrosion on them. Because I was familiar with the ingots from the Bakau and the Lena Shoal, I could see the similarities to the ingots of the Santa Cruz, and identify them properly.

Additionally, we have the problem of inventory counts. The beads were not counted individually, but by weight. Also, they were not attributed as coming from a specific vessel. It was necessary to address this issue as best as possible, by noting the commentary of bead concretions on certain ceramic jars. Because the published material was only on the ceramics in the assemblage, a voice for the non-ceramic material needed to be presented. Initially to make them known to academic circles, but also to analyse patterns of trade in said materials. The tin ingots were stressed to reinforce the rise in the raw material trade. Patterns of lading between the glass beads and specific types of vessels was observed which could reveal trading trends in these objects.

6.2 Broader-themed contributions

We looked at the contribution that this thesis had on a "by-shipwreck" basis. The larger contribution, however, is seeing the benefit of looking at a range of shipwrecks over a period of time. This gives us the opportunity to see larger trends in the products being traded over time, which also reveal other players in the regional trading network, as well as showcasing the diversity of products that existing ceramic centres are contributing to trading models. These models reveal the highly nuanced network of regional trade.

6.2.1 Artefact Observations

As mentioned in Chapter 3, there is an increase in the trade of raw metals from the Early Ming into the Middle Ming Period. Lead ingots are found in the Rang Kwien and the Ko Si Chang III. However, no lead ingots are found in the later wrecks of the Lena Shoal and Santa

[598] Kintanar 2014; Orillaneda 2008b

Cruz. Lead ingots could be a product that is exclusively traded around the mainland. Or at least a product not bound for archipelagic Southeast Asia. Copper ingots are found in the assemblages of the Rang Kwien and the Ko Si Chang III. The Ko Si Chang III had copper ingots in two forms: a long, baguette-shaped ingot, and a plano-convex, bun-shaped ingot. The differences in shape are notable, but we have no sourcing reference to deduce if they are coming from different areas. Tin ingots are found on the Bakau (Early Ming) but the quantity increased in the assemblages of the Lena Shoal and the Santa Cruz (Middle Ming).

There is also an increased trade in glass beads, since they are only found in the Middle Ming wrecks of the Lena Shoal and the Santa Cruz. This is supported by their presence in the other mid-late 15th Century wrecks of the Pandanan[599] and the Brunei. [600] This shift could also be an indicator of the emerging importance on markets in archipelagic Southeast Asia.

By analysing and identifying the star anise, we have also provided proof of the continued trade of this product from China to western markets during the Ming Dynasty. This is probably just the start of what could be gleaned about the trade of 'perishable' organics.
We also have learned more about crew life. We see what products they are eating; pigs, eggs, crabs, and fish sauce or smoked fish. We see evidence of individual property and trade patterns by analysing the pepper in the blue-and-white box from the Lena Shoal and the beads in the blue-and-white box with glass beads inside. We can glimpse at the social aspects of crew life, with gongs and game pieces, along with understanding practices like lime-container usage. We can use artefacts like ink stones to denote those roles on board that possess certain skills that are not common for most crew members.

6.2.2 Trade Themes

6.2.2.1 Ming Ban

One of Brown's conclusions discusses the rise in the ceramic industries of Southeast Asia following the Ming dynasty's ban on external trade.[601] Brown's major theory is that the Ming Ban created an impetus of local agency. Thailand and Vietnam are ceramic centres that have a long, established history of design and manufacture. The existing infrastructure allows local ceramicists to fill the void created by the absence of Chinese ceramics. The Ming Ban

[599] Brown 2009, p.173; Cayron 2002
[600] L'Hour 2001a; L'Hour 2001b
[601] Brown 2009, pp.69–70

accelerates the increase in the trade of Thai ceramics. These centres have been steadily gaining ground on the market share of trade ceramics, and the Ming Ban was one of the events that helped propel these types of wares to the fore.

Brown's theory of the economic sector coincides with Manguin's idea in the rise and nuanced iterations of the "hybrid-style Southeast Asian junk". He claims that the tradition has its beginnings of the 13th Century, but technological advances to the type come in the 15th Century when "traders were banned from building large ships in their home country and their commercial activities were restricted by renewed closed-country policies".[602] Three of the ships in this study were identified as 'Chinese built', yet they all are dated to years when the Ming Ban was in effect. This could reflect several scenarios. It was possible that the official Ming Ban was not strictly enforced. Whether through bribery, or complacence, governmental officials could have allowed these ships to transport their goods. While the Ming Ban was in effect, there may have been years that permission was 'relaxed'. These ships could have been part of one of the voyages of the Zheng He Treasure Fleet, which was officially sanctioned by the Chinese government and allowed to travel during the Ming Ban. They also could have been pirate vessels, who abided by no official trade laws and traded wherever and whenever they decided to.

All of the ships were primarily dated via Radiocarbon dates from the timbers of the shipwreck. This is important to understand because in this manner, we cannot study the assemblage without studying the ship. Normally the assemblage date is taken as an associative source when dating a shipwreck. Timber Radiocabon dating provides us with a general date with which to ascribe to a shipwreck. Dating the ship is then fine tuned from there due to the work done by ceramicists and archaeologists that date forms and types of ceramics when found in a kiln site or dated in an associative context with a coin or something with a date on it.[603]

This similar trend in local agency is seen in this case study. A number of other sectors of industry in Southeast Asia outside of ceramic manufacture seem to be benefitting from the Ming Ban as well. Sectors like glass bead manufacturing, raw metal mining and the bronze-making industries are also propelled to the forefront of supply given the lack of Chinese goods entering the market. This is also most probably related to the fact that local producers

[602] Manguin 1993

[603] Certain ceramics can also dated a shipwreck by identifying the Chinese Reign mark/stamp found on them.

could also now add these items cheaply to ships, since they were piggy backing other cargo onto its main cargo of ceramics. These then become complimentary cargoes.

Brass arm bangles are common in shipwreck assemblages from the mid-late 15th Century shipwrecks of the Lena Shoal,[604] Santa Cruz,[605] and the Brunei. [606] The fact that the Pandanan wreck did not carry brass bangles and was heavily laden with Vietnamese wares could suggest that the bangles are fabricated in Thailand.

There appears to be evidence of a larger contribution in the trade network in goods and commodities from the Malay Peninsula. The appearance of tin ingots and glass beads in the late 15th Century stress the importance of the Malaccan Sultanate as a significant part of the maritime trade network, if not simply for the peninsular port of Patani, then for the Sultanates' naval control of the Straits of Malacca and the governance of trade between the Indian Ocean and South China Seas.

While pepper represents a small amount of archaeological material in this study, but its presence shows that the western markets of Sumatra and possibly India are enmeshed into this trade network.

With the ships from the Middle Ming period, Southeast Asian "hybrid-style" ships, it appears as though Southeast Asia is "picking up the mantle" of regional trade. The artefacts from the Lena Shoal and the Santa Cruz reflect a new diversity of cargo, accompanied by an influx of newly mass produced ceramics from China. Yet, even though much of the trade commodities from China are ceramics and porcelain, there are other types of products that have a wide popularity outside of China. Many of these ships had iron woks in their assemblages. The Bakau also was carrying several bronze mirrors and tweezers. The presence of these non-ceramic items lend credence to the nuanced trading patterns. In terms of trade, there is more to these Chinese ports than simply the trade in ceramics. Obviously, China is well versed in the fabrication of metal objects, and the wide trading network of iron pots is revealed in the archaeological record both on these ships and terrestrially. The finer products like mirrors and tweezers show a similar pattern of trade, but catering to a more distinguished clientele.

6.2.2.2 The network narratives of the wrecks in the case study

[604] Goddio et al. 2002, p.241
[605] Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996
[606] L'Hour 2001b; L'Hour 2001a

This thesis was designed to see how a holistic approach to shipwreck artefacts fits within a ship's existing ceramic narrative. By analysing the all of the artefactual material of the shipwrecks, it has revealed a more nuanced trade network.

Turiang (1370 -1400 CE):

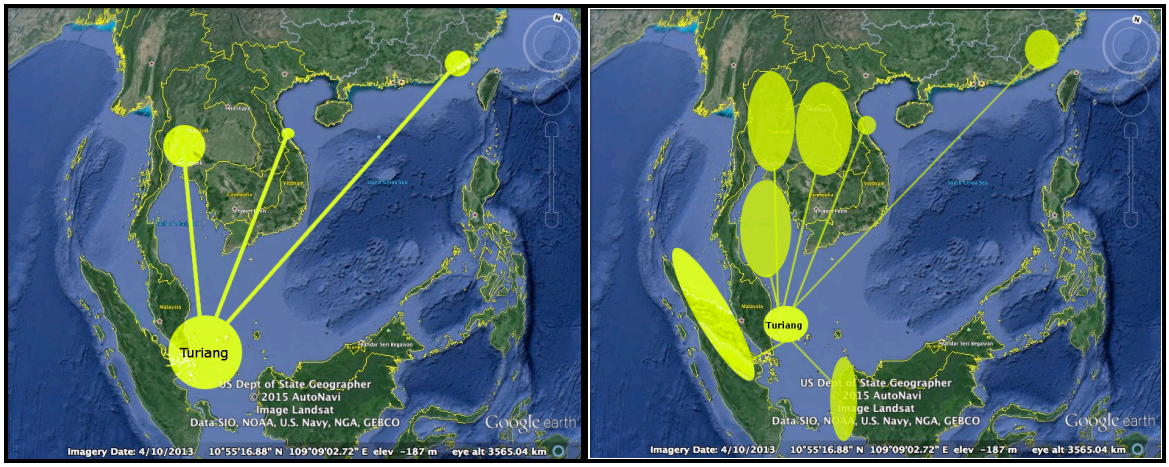


Figure 6. 1: Turiang ceramic network (left) compared to its holistic network (right). (Google Earth)

The ceramic narrative of the Turiang, tells a large portion of the story. The ship has trade connections with Vietnam, Thailand, and China via the ceramics from those three respective areas. Yet the network only represents a small portion of connectivity to the region. The assemblage comprises of iron sand from either Java or northern Sumatra, along with fish from either the Gulf of Thailand or the western portion of the South China Sea. The ship has stronger ties to Thailand via the sphalerite, and a strong tie to the mainland through the ivory tusks (Fig. 6.1). Whether or not we know about which ports the Turiang visited, we can clearly see larger network of trade when we use the whole of the artefact assemblage.

Rang Kwien (1400 – 1430 CE)

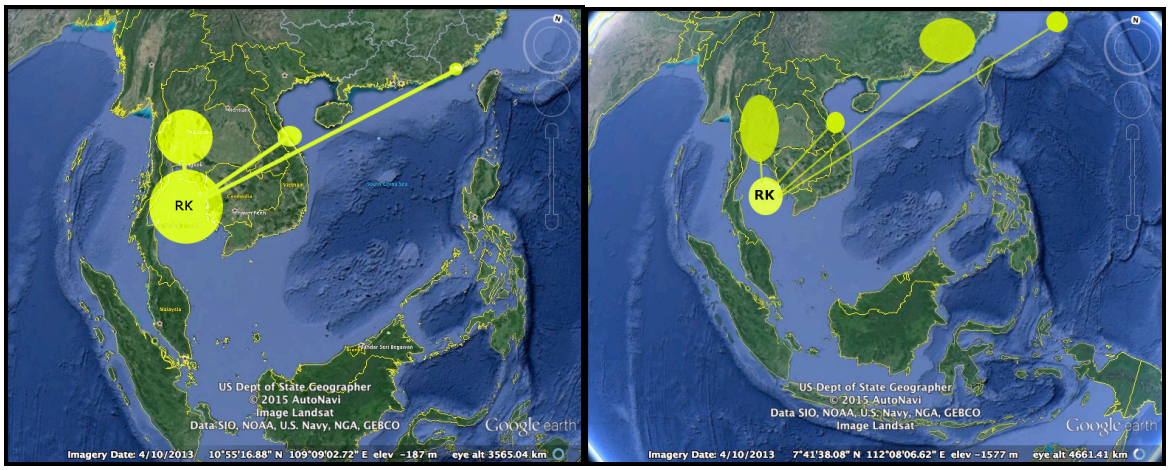


Figure 6. 2: Rang Kwien ceramic network (left) compared to its holistic network (right). (Google Earth)

The holistic network of the Rang Kwien is not entirely dissimilar to the ceramic network. There are ties to the three ceramic centres (China, Vietnam, and Thailand), yet the metals of the Rang Kwien tell a more nuanced story (Fig. 6.2). The assemblage consisted of several thousand coins from China, as well as a tsuba from Japan. The holistic network shows a more diverse product trade with China, due to the additional artefacts manufactured from there. The tsuba's presence demonstrates a technical (and possibly social, via the employment of samurai) connection to Japan. Given that the Rang Kwien had Thai ceramics in the assemblage, and that there was still several thousand Chinese coins on board, it is likely that the ship was intending to travel to other foreign ports of call; perhaps the Sultanate of Malacca, or points farther west.

Bakau (1410 – 1430 CE)

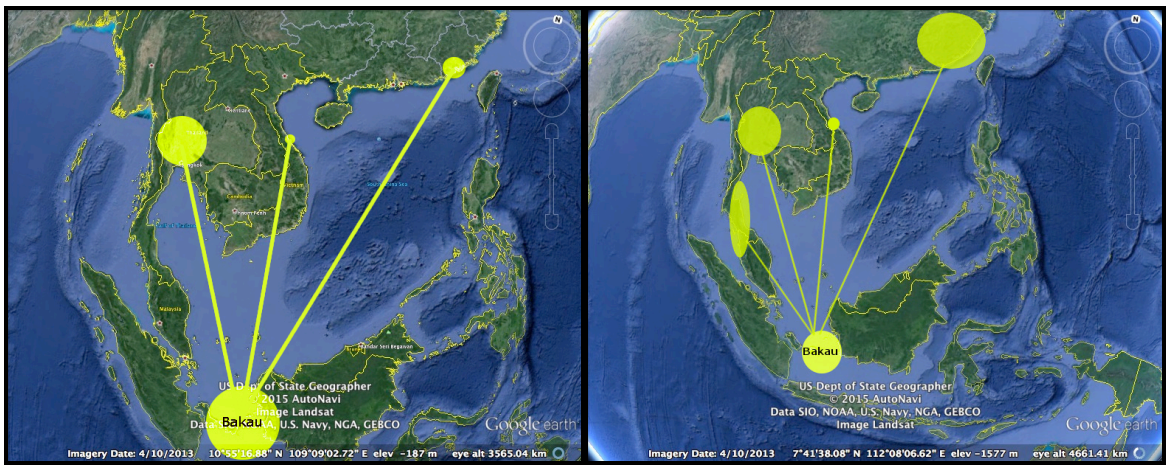


Figure 6. 3: Bakau ceramic network (left) compared to its holistic network (right). (Google Earth)

The network of the Bakau is also similar to its ceramic network. There are artefactual connections to the three ceramic centres (China, Vietnam, and Thailand), yet the non-ceramic artefacts reveal more about the trade patterns of the Bakau (Fig 6.3). The representation of China is more pronounced due to the amount of metal artefacts found in the assemblage (iron pots, bronze tweezers, mirrors, and gongs). Grinding stones and querns are likely from Thailand. Tin ingots from the assemblage is from the Malaysian peninsula, giving us a connection to the Malaccan Sultanate, either via direct trade or trade by proxy.

Ko Si Chang III (1460 -1487 CE)

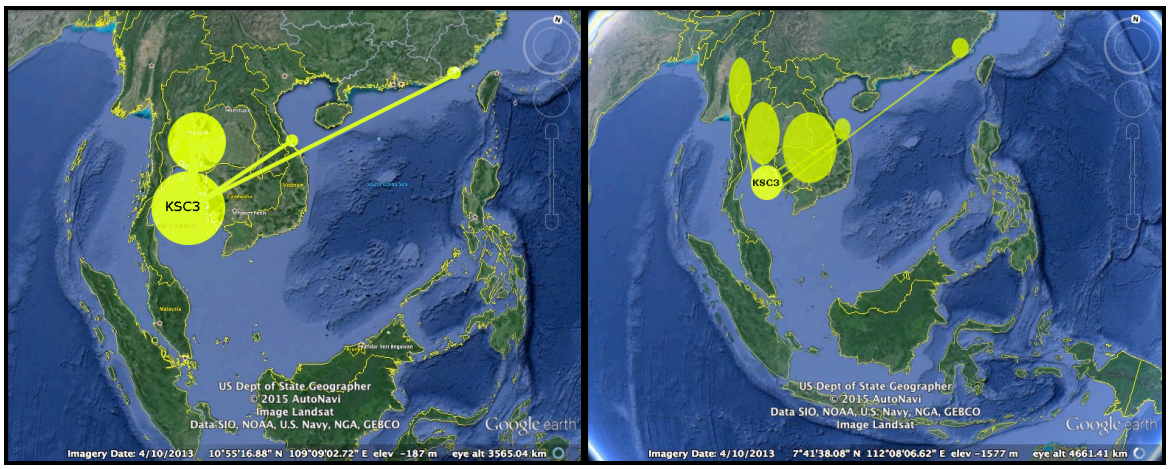


Figure 6. 4: Ko Si Chang III ceramic network (left) compared to its holistic network (right). (Google Earth)

While the network pattern does support its interpretation of a local trading vessel, the holistic network of the Ko Si Chang III shows a lot more diversity than its ceramic network alone (Fig. 6.4). The regional connections to the assemblage are still the same (China, Vietnam, and Thailand), but we see that other non-ceramic products highlight a greater connection to mainland Southeast Asia. Lead and copper ingots from Thailand are present, as well as ivory and bronze limepots from the mainland.

Lena Shoal (1488 - 1505 CE)

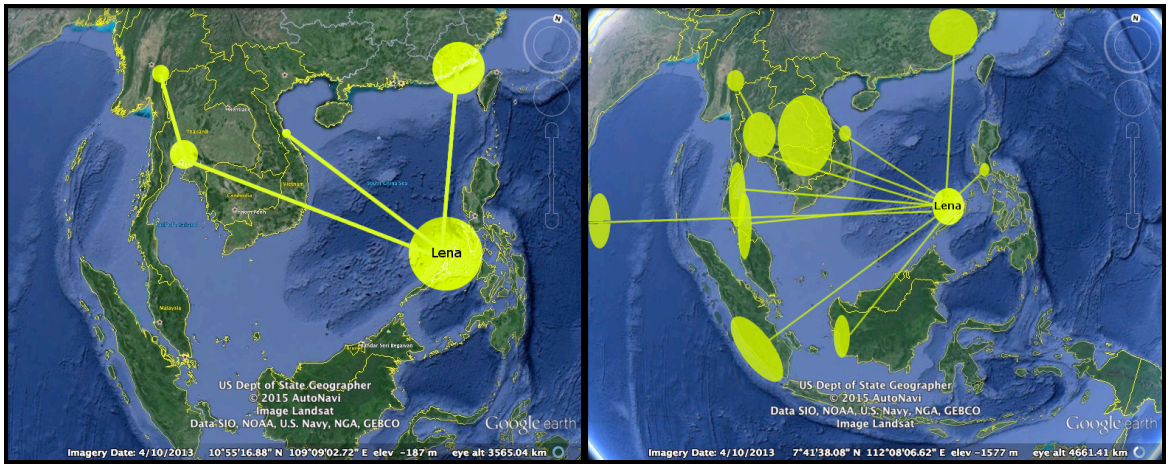


Figure 6. 5: Lena Shoal ceramic network (left) compared to its holistic network (right).

The holistic network of the Lena Shoal is in stark contrast to its ceramic network (Fig. 6.5). The assemblage contains ceramics from China, Vietnam, Thailand, Burma and the Philippines. China's connection is more diverse with iron woks and needles, bronze coins, cannons, and lacquer ware. Mainland Southeast Asia has additional connections through the ivory tusks and bronze bangles, and glass beads found within the assemblage. Tin ingots come from the Malay Peninsula, and copper repoussé wares are likely coming from Java or Sumatra. Pepper is also present from either Sumatra or India. The archaeological evidence provided by this shipwreck assemblage shows the diversity of cargoes around this time.

Santa Cruz (1488 - 1505CE)

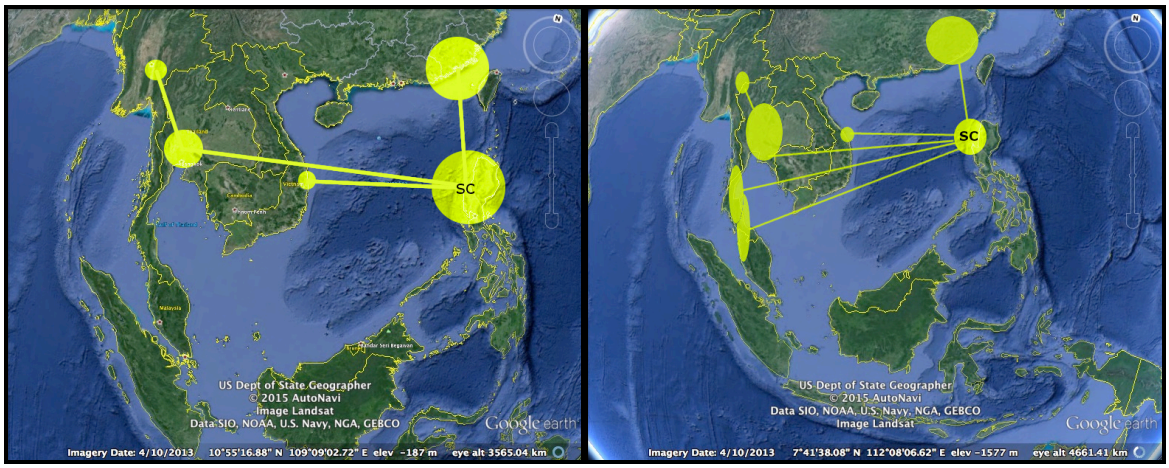


Figure 6. 6: Santa Cruz ceramic network (left) compared to its holistic network (right). (Google Earth)

The holistic network of the Santa Cruz is also much more nuanced than the ceramic network as well (Fig. 6.6). The assemblage has connections with four ceramic centres: China, Vietnam, Thailand and Burma. It also diversifies its connection to China with the presence of iron pots, bronze cannons and lacquer ware. Glass beads and brass bangles are present from mainland Southeast Asia. Tin ingots from Malaysia were also part of the assemblage.

By implementing these network models and noting specific non-ceramic artefact trends, future work can be done with other shipwrecks and their assemblages by integrating them into these models. Ships dated within the date range of the study can be added to flesh out the framework and the networking patterns in order to enhance the data. Other shipwrecks outside the date range can offer a contrasting comparative when we focus on differing eras and regions. Indian Ocean and South Asian influences may change the trade dynamic of the region, as well as the introduction of European players in the Early 16th Century. It makes for very interesting possibilities.

6.3 Excavator Themes

6.3.1 Ceramic Bias

In most cases, when the excavation publication is not in an academic journal or other such scholarly publication, there is a general tone in the way archaeologists write about artefacts and how they should be interpreted: Objects that have a high monetary or "art" value deserve more study and appreciation than lower valued objects. There is a hierarchy of appreciative value assigned to various objects. Ceramics trump most other artefacts; jewelry and glass beads are high on this list; stone, wood, and metals, depending upon their condition are located at the lower end of this scale.

In this case study, we see it in the publications of the Turiang, the Bakau and the Lena Shoal. The published work of the Turiang is largely focussed on the ceramics.[607] A large percentage of the ceramics has given to Sjostrand to sell through his company, Nanhai Marine Archaeology, to pay for the excavation.[608] Sjostrand knew that ceramics sell, and he committed to the excavation not only for its contribution to the scholarship, but to cover its costs through the sale of ceramics.

Tilman Walterfang's sale of the Bakau was predicated on the public fascination of ceramics. He claims that, "(a)n auction and disbursement in the art market was never acceptable for

[607] Brown & Sjostrand 2000
[608] Sjostrand n.d.

me".[609] This may be true to a certain point, but Walterfang recognized that there must have been some profit to sell, otherwise he would not have excavated the shipwreck. Treasure hunters survey an initial site to see what is present archaeologically, but ultimately to recognize the site's potential for profit. Goddio's book on the Lena Shoal is patterned in the form of a coffee table book, with a heavy focus on the ceramics found on board.[610]

There are even sub-hierarchies within the various objects. Porcelain and other Chinese ceramics are stressed over the mundane ceramics – the containers and the cooking pots. These mundane objects tell a more enriching narrative, because of the function they are serving at a site. These are not new products, and they may have less decoration, but they have a rich social history. The shipwrecks in this case study were all heavily laden with ceramics. While the mundane ceramic does not have as wide of a popular market, the markets where they do thrive expose a rich narrative in regional trade.

Schiffer describes a concept of materiality whereby artefacts play supporting roles to other, more valued (either functionally or artfully) artefacts, depending upon how the artefacts are analysed.[611] For example, if the focus is trading and trade routes, the material inside the jar has the main role, and the jar is the supporting role. If we are discussing ceramics typologically and functionally, the ceramic jar becomes the main role. The material inside takes a supporting, or, in some cases of this case study, even no role. Whichever the role of the ceramics, though, it proves the interconnectivity between the containers and what they contain. We can and should look at them as one item sharing a narrative, whether it is a temporary or permanent pairing.

6.4.2 Methods of Excavation/Conservation/Protection

This case study analysed the shipwreck excavations from a number of sources throughout the South China Sea–excavations from academic institutions, salvage companies, museums, and amateur archaeologists. All of these excavations have contributed positively to the body of knowledge that is Southeast Asian maritime trade in the 14th and 15th Centuries. The published materials may vary in content or motive, but it is important to acknowledge that valuable research can be gleaned from the various publications.

However, there still can be improvement in data collection and artefact subjectivity that would allow the discipline to achieve a higher level of scholarship.

[609] Walterfang n.d.
[610] Goddio et al. 2002
[611] Schiffer 1999, p.82

The work on the Turiang would be benefit from a reanalysis of the non-ceramic material. Today, there are many research labs willing to study the sphalerite and the fish bones in a more detailed context to better "round out" the shipwreck narrative.

The Rang Kwien is a very unique ship. Between the precious jewelry, the coins and the Japanese tsuba, there are social aspects of the ship that need analysis. This wreck is a wonderful opportunity to discuss the medieval Chinese diaspora, fine artistry, and personal protection.

The Bakau is another intriguing shipwreck. Flecker's publication of the Bakau became a sort of "rescue publication"; a way to put the ship on academic radar so that the material does not get lost. A re-analysis of the metallurgical assemblage would be beneficial. We know that Flecker knows how to do this well, because of his work on the Intan and the Beilitung.[612] While we know little of the excavation itself because the salvage was not interested in that data. They wanted to be efficient in the recovery, to assume a better profit margin. However, we do benefit to be able to study the whole of the assemblage, which I will discuss below.

The Ko Si Chang III was a thorough, subjective publication that is worthy of academic merit. It is a standard that all excavations should reach for.

The Lena Shoal represents the first time a publication discusses non-ceramic material in Southeast Asian assemblages in greater depth. It also is a first to market a book that caters to connoisseurship as well as publishing the technical analysis of some of the material.

The Santa Cruz is currently an unpublished archaeological report. It is exciting to interpret the benefits and drawbacks working with unpublished material. Since the excavation inventory and reports were so thorough that we can fully recreate the wreck to better understand the cargo lading and wrecking processes. Bobby Orillaneda is analysing the aspect of wreck recreation in his D.Phil Thesis at the University of Oxford.[613] Yet, when we are working with unpublished, initial analysis reports, it is necessary to question the initial interpretations.

6.4 Conclusions: The future

Now that we have discussed the nuanced patterns of trade, and learned a bit about the crews that sailed them, it begs the question, "What next?" As I have reassessed these excavations, others should analyse what I have put forth, to test the merit of certain claims. Largely that involves ever deeper research into many of these items and areas of manufacture.

[612] Flecker 2002a; Krahl et al. 2010
[613] Orillaneda 2008a

We need to investigate manufacturing and mining centres of the Early Modern Age in Southeast Asia in an effort to better understand the trade between the ports and the hinterlands in these products. These sites would reveal evidence about copper refining and ingot shapes, tin ingots and their sources and the bronze workshops of the brass bangles. We can also learn more about copper workshops to better identify the copper repousse ware from the Lena Shoal. The stone carving industry in the region has not been investigated since the excavations of the Dvaravati workshop in Thailand in 2006.[614] Further excavations on stone quarries need to be conducted in order to better understand the quern and grinding stone trade. A more scientific approach is required to analyse the stone artefacts of the Bakau, the Lena Shoal and the Santa Cruz to note further commonalities and provenance. The same is true for the bead trade. The bead manufacturing sites need to be vetted to put them in better context of their respective trading networks. We need greater scientific analysis of these artefacts to correlate the differences between found manufacturing centres.

There is a great need to revisit older excavations and assemblages in an effort to look more at the 'insignificant' items. There are mundane items in these assemblages that have most likely been overlooked. There is an archaeological focus to learn more about the lives of the people in past cultures, it would benefit the discipline to look more closely into the utilitarian objects to understand daily life. Better research into objects like fishhooks, spears and game pieces can give us an introspective into sailor work-life and social-life.

The scholarship in maritime trade would benefit from the establishment of an assemblage database. The assemblages from various regional shipwrecks could be compiled onto one large database, allowing researchers to cross-reference and collate artefactual data. This would provide information on artefactual tends in popularity, possible shipping routes for certain items, or highlight unique items that would otherwise be obscured in separate, individual databases. Understanding their artefactual context is one line of research, there is also a necessity to analytically understand these artefacts, their connections to each other and the broader world around them. There needs to be a more cognitive approach to Southeast Asian artefacts and the meanings behind them.

Perhaps the most important work for the future is to continue excavating these shipwrecks at a professional, academic level. More countries need to ratify the UNESCO Convention on Underwater Cultural Heritage, to increase the protection of underwater sites from treasure

[614] Indrawooth 2006

hunters, salvagers and looters. The worst thing that we lose when we excavate a site, is archaeological context. Once that environment is disturbed, it cannot be undone. The documentation of the excavation provides us with intertpretive detail that amateur excavations do not. Without oversight and diligence, we lose so much information to folly.

These ships are not homogenous entities. They are constructed by a multitude of materials, are manned by diverse crews, and carry diverse cargo. They represent a shared heritage of many cultures. To stress any one aspect or artefact type over another when discussing maritime trade is a disservice to the interconnectedness of the material and the cultures attached to it. A multidisciplinary approach to archaeology offers us a more vivid look into the peoples of the past and their multifaceted relationships, as well as offering reflections between these past cultures and our present selves.

Appendix 1: Ceramic Distribution

Ceramics (via Area of Manufacture)	Turiang[i]	Rang Kwien[ii]	Bakau[iii]	Ko Si Chang III[iv]	Lena Shoal[v]	Santa Cruz[vi]
Chinese	**2,245**	**9**	**423**	**5**		**9,382**
Monochrome ware	500		128		12	543
Green-glazed ware/ Celadon Ware[vii]	900	9	60		37	5,024
Brown and black-glazed Wares	845		223		"Large quantities"	Present[viii]
Fahua ware					< 5 Fragments	
Blue-and-White				5	2,084	3,538
Unknown			12			
Vietnamese	**500**	**46**	**5**	**7**		**40**
Monochrome ware[ix]		11			1	
Underglaze-black wares	500		5			
Vietnamese Blue-and-White wares[x]		35		7	28	40
Thai	**3,730**	**196**	**872**	**280**		**982**
Earthenware		131	524	258[xi]	Present[xii]	
Monochrome Wares						
Early Green-glazed ware	500	12				
Celadon ware			6	1	400-800	
Brown and Black-glazed ware	130	39	232	22	Present[xiii]	
Underglaze wares	3100		110	1	-	
Burma	**0`**	**0**	**0**	**0**	**Yes**	**358**
Burmese Celadon					Present[xiv]	358
Brown and Black-glazed wares					1	
Philippines	**0**	**0**	**0**	**0**		
Earthenware[xv]					Present[xvi] **Error! Bookmark not defined.**	
Misc. Sherds						
Unknown		**9**		**2**	**9**	**104**

Appendix 2: Metallurgical Distribution

Artefacts	Turiang [xvii]	Rang Kwien [xviii]	Bakau [xix]	Ko Si Chang III [xx]	Lena Shoal [xxi]	Santa Cruz [xxii]
Raw Materials						
Iron						
Iron Ingots					Yes [xxiii]	
Iron Granules	present [xxiv]					
White Metals						
Lead Ingots		Yes? [xxv]		2020		
Tin Ingots			3		187	117 [xxvi]
Other Material						
Long Copper Ingots		11				
Round Copper Ingots				20		
Manufactured Objects						
Trade Goods						
Mirror		1 [xxvii]	10			
Mirror Handle			9			
Tweezers			6			
Gong		1	17		7	12
Iron Pot (wok)		Yes?			"numerous" [xxviii]	22
Iron Needle					8	
Spiral Bracelets					30	>100
Copper Repoussé' Ware					23	
Copper Sheeting						
Ship Use/Personal Items						
Lime Container		3		3		
Phallic Amulet				1		
Net weight			25			13
Line Weight			17			
Sounding weight			2			
Bronze Bell		1	1			
Cannon			10		5	6
Chain			3			
Dish			5			1
Fishhook		Yes?	2			
Dagger			1			
Handle			3			
Iron Ring						

Artefacts	Turiang [xvii]	Rang Kwien [xviii]	Bakau [xix]	Ko Si Chang III [xx]	Lena Shoal [xxi]	Santa Cruz [xxii]
Spoon			1			
Spear/harpoon		Yes?	1			
Scale Weights			9	1		3
Copper Ring			6			
Cauldron						1
Bronze Crown						1
Plumb Bob						
Bronze tool(hammer)		1				
Gold Ring (Jewelry)		1				
Gold Bracelet		2				
Hairpin		Yes?				
Forceps		1?				
Tsuba		1				
Oil Lamp			1			
Unassigned Objects						
Bronze Bowls			4			
Pewter Carafe			3			
Pewter Kendi			1			
Coins		4,834	197 [xxix]		3	
Lid			6			
Scissors			1			
Metal Implement						
Metal Fragment						
Box						1
Unidentified Objects						
			5			

Appendix 3: Organic Material Distribution

Artefacts	Turiang [xxx]	Rang Kwien [xxxi]	Bakau [xxxii]	Ko Si Chang III [xxxiii]	Lena Shoal [xxxiv]	Santa Cruz [xxxv]
Fibrous Material						
Palm leaves					Yes [xxxvi]	
Bamboo fibres					Yes	
Foodstuffs						
Egg	Yes [xxxvii]	Yes		"a group" [xxxviii]		
Mangrove crabs		Yes				
Spices					Yes? [xxxix]	
Pepper					Yes [xl]	
Star anise			Yes [xli]			
Ivory						
Elephant Tusks	3-4			Several	~80 [xlii]	
Nuts						1 [xliii]
Areca Nut		Yes [xliv]		Yes [xlv]	Yes? [xlvi]	
Coconut shell						1 [xlvii]
Shell						
Shell hemispherical piece					43	
Shell Disc					2	
Bones			3 [xlviii]			
Animal Bones		Yes [xlix]				
Fish Bones	Yes [l]					
Lacquer ware						
Lacquered Box					~5 [li]	
Lacquered wood			1			1 [lii]
Wood						
Wooden Box						5 [liii]
Wooden handle			1			
Wooden stick			1			
Wooden implement						1
Wooden Object			4			12

Appendix 4: Stone, Mineral and Glass Artefact Distribution

Artefacts	Turiang[liv]	Rang Kwien[lv]	Bakau[lvi]	Ko Si Chang III[lvii]	Lena Shoal[lviii]	Santa Cruz[lix]
Raw Material						
Sphalerite/Zinc	Yes[lx]					
Red Pigment			7			
Ballast Stone					<5	2
Manufactured Material						
Jewelry						
Beads					"Thousands"	1K plus ~43[lxi]
Yellow						~111[lxii]
Carnelian						115 plus 1 "bag"
Black						2 bags
Blue						1 kilo of blue and black
Glass Bracelet						33
Marble Material						
Marble Cylinder					1	
Marble disc					11	
Unidentified Marble piece					3	
Stone Material						
Single Round Grinding Stone			9			
Double Round Grinding Stone			1			
Sharpening Stone	1				1[lxiii]	
Stone Quern			16		1	3[lxiv]
Stone Rolling Pin			16		1	1
Ink Stone			1			1
Unidentified Stone Object			13			2

[i] These numbers are "estimated" amounts, as per Brown and Sjostrand, 2000, page 17.
[ii] Intakosai 1983
[iii] Flecker 2001b
[iv] Green et al. 1987; Brown 2009, p.46,
[v] Goddio et al. 2002; Kintanar 2014
[vi] Orillaneda 2008b These quantities represent relative approximations. The National Museum of the Philippines and the HILTI Foundation settled on a "50-50" split of the ceramic material. The artefact list in possession is only from the National Museum; therefore I am doubling the counts on each ceramic type identified. For Items that I do not have counts for, I am using the "percentage-of-material-by-location" data from Orillaneda's Master's Thesis (see citation). Therefore, where types of material could not be ascertained, Region counts (e.g., "Chinese", "Vietnamese", and "Thai") are noted within this Appendix.
[vii] Roxanna Brown separated out "Green-glazed" and "Celadon"(Brown and Sjostrand, 2000). Rooney (Goddio, et al., 2002) defines no difference between the two, yet Brown does not say why she made a distinction between these products. All "green-glazed wares" will be known as "Celadon" for the purposes of this thesis.
[viii] 56 brown wares and 5 black wares have been identified from the artefact spreadsheet, yet no provenencial information was given. Many have simply been identified as "tall jar", with no reference to glaze or non-glaze. . No exact count can be given until a proper tally of the material is performed.
[ix] Monochrome wares are defined for the purposes of this thesis as any single coloured glaze that is not "green" or "black/brown" glazed wares (i.e. white, or yellow).
[x] Also known as "underglaze blue" in some catalogues. Both terms will be used synonymously throughout the thesis.
[xi] This does not include the 2,888 pottery sherds that were identified as "earthenware". Green et al. 1987
[xii] No official tally of earthenware ceramics has been published. Isolated examples are documented in Goddio, et al., 2002.
[xiii] No official tally of these types of ceramics has been published. Isolated examples are documented in Goddio, et al., 2002.
[xiv] Brown analysed this material and believes that some of the identified Thai Celadon is actually from kilns sites in Burma. Brown 2009
[xv] Monique Crick uses the term "terracotta", which is a type of earthenware and identified as such within the scope of this thesis. Goddio et al. 2002
[xvi] Brown analysed this material and believes that some of the identified Thai Celadon is actually from kilns sites in Burma. Brown 2009
[xvii] These numbers are "estimated" amounts. Brown & Sjostrand 2000
[xviii] Intakosai 1983
[xix] Flecker 2001b
[xx] Green et al. 1987
[xxi] Goddio et al. 2002
[xxii] Orillaneda 2008b; Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996
[xxiii] The ingots were concreted to the hull frame. They could not be counted and were not brought up from the sea floor. Goddio et al. 2002
[xxiv] Brown and Sjostrand noted "Lumps" of iron oxide previously in granular form (2000, 39.)
[xxv] A recent publication and subsequent presentation mentions the accession of "lead ingots", but no physical or photographical evidence has been submitted. Ploymukda 2013b
[xxvi] The unpublished itemized excavation report mentions most of these as "lead ingots", but XRF analysis proved otherwise, see Chapter 3.
[xxvii] As described in Chapter 3, instances of an item tallying less than 3 are considered as "Ship use/Personal items" and not as "trade goods".
[xxviii] Exact counts have not been published. The woks were noted as "numerous cast iron pans of various sizes were found resting on a bed of iron ingots. The pans were stacked in piles of 10 arranged by size". Goddio et al. 2002
[xxix] Coins were individually counted except one stick of concreted coins (estimated count of 30) for a final count of approximately 197.

[xxx]These numbers are "estimated" amounts. Brown & Sjostrand 2000
[xxxi] Intakosai 1983
[xxxii] Flecker 2001b and Liow 2013
[xxxiii] Green et al. 1987
[xxxiv] Kintanar 2014; Goddio et al. 2002
[xxxv] Orillaneda 2008b; Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996
[xxxvi] Goddio reports that, "The Iron ingots were tied together with bands of split bamboo in bundles of 10 and were arranged in layers separated by racks made of plaited palm leaves. " (2000, 40). Neither material was brought up from the site. In the case of the bamboo, the material was left due to its concretion within the metal ingots (which were not excavated as well). Only imprints of the palm leaves were left in the concretions, therefore no physical material could be recovered.
[xxxvii] "Eggs" were found inside one single storage jar. No exact amount was published. Brown & Sjostrand 2000
[xxxviii] This "group" of eggs were all found in one earthenware jar. Green et al. 1987
[xxxix] Scott notes that "spices" were part of the excavation assemblage. She also singles out "pepper" in the same sentence, so I assume that there are other spices, either unlisted or unanalysed. Goddio et al. 2002
[xl] Pepper was found only in one porcelain pot from the Lena Shoal excavation. Goddio et al. 2002
[xli] Samples of the material were taken from two jars and analysed by Dr Cristina Castillo, at UCL. She confirmed them as being star anise. See Chapter 4.
[xlii] Forty-one (41) tusks were excavated from the site, but in the initial survey and early photographs, it was believed that the count of tusks were closer to 80. Local fishermen looted about 30 of them during the period of time between the initial survey and the actual excavation. Approximately 10 were left in situ due to concretions between the tusks and the iron ingots (also left in situ). Goddio et al. 2002
[xliii] The unpublished inventory does not distinguish the type of nut that was recovered. Orillaneda 2008
[xliv] No physical or photographical evidence was published; therefore no exact count was recorded.
[xlv] Several were found within the site, yet only one of them was actually contained within an earthenware jar (along with some shards (sherds?) and bone). Green believes that it could be possible that they are an intrusion. Green et al. 1987
[xlvi] Although there is no physical or documented evidence of this material noted within the catalogue, Rosemary Scott states that, "Indeed the porcelain boxes on the Lena Shoal junk contained precious objects such as combs, a red lacquer box, glass beads, or spices, pepper and areca nuts." Goddio et al. 2002
[xlvii] Found inside a storage jar. Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996
[xlviii] No distinction has been made between human or animal. They are too large to be fish, and assumed to be animal.
[xlix] Identified as Pig bones, unknown published quantity. Intakosai 1983
[l] Brown (2000, 18) states that, "(a) number of pottery jars contained fish bones." No exact counts were published.
[li] No official count of this material has been published. It is confirmed that there was at least one lacquer ware "comb" and "boxes" (plural). There are a total of five photos of lacquer ware items in the catalogue, therefore I cannot commit to any more than that count. Goddio et al. 2002
[lii] The line item does not distinguish if this is a fragment from a piece of lacquer ware or simply a stick that has been lacquered. Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996
[liii] These are identified in the inventory as being "round wood", or "possibly cover jar(s)". It is possible that they are lacquered boxes, but not identified as such. For the purposes of this Appendix, they are identified solely as "wooden".
[liv]These numbers are "estimated" amounts. Brown & Sjostrand 2000
[lv] Intakosai 1983
[lvi] Flecker 2001b; Liow 2013
[lvii] Green et al. 1987
[lviii] Goddio et al. 2002; Kintanar 2014
[lix] Orillaneda 2008b; Orillaneda & Underwater Archaeology Department National Museum of the Philippines 1996
[lx] "Small chunks" were found in several storage jars from the wreck. Brown and Sjostrand, Turiang, 39.
[lxi] The colour of the beads was not identified.
[lxii] A jar had an unidentified number of "beads on its mouth".
[lxiii] Possibly not a sharpening stone but a grinding stone.

[lxiv] Identified as a stone “altar”

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