

Shipwreck Archaeology in the Red Sea and the Potential of Exploration along the East African Littoral

Ralph K. Pedersen, PhD

Paper presented at the conference
Exploring China's Ancient Links to Africa.
Addis Ababa, October 29-31, 2014.

Contact information:
The Red Sea Institute for Anthropological Research
pedersen@redseainstitute.org



Abstract: *The archaeology of ships in the Red Sea and Indian Ocean lags behind other areas of the world. Relatively few shipwrecks there have been archaeologically investigated, and only one Red Sea wreck from the era before Islam has been excavated. This paper discusses the author's shipwreck excavation at Black Assarca Island, Eritrea, as well as recent surveys and discoveries in Saudi Arabia. Based on these studies, the potential for similar archaeological endeavors—including possible methodologies and survey areas—along the East African coast of the Indian Ocean is outlined.*

Seafaring in the Red Sea in antiquity is relatively understudied when compared to our knowledge of that of the Mediterranean Sea. Since its inception over fifty years ago, nautical archaeology has revealed, by some estimates, over 2000 shipwrecks dating from the Bronze Age into the late Medieval period. The bulk of these shipwrecks date to the Roman Empire, testifying to the amount of shipping that occurred on the Mediterranean and reflecting the trade and commerce the empire needed to thrive.

The Red Sea is a different story. Although the Romans used this sea as its main conduit to India to acquire the spices and silks that either originated there or were transshipped from Indonesia and China, few shipwrecks have been found in the Red Sea, and fewer still have been archaeologically investigated. The reasons for lack of investigation are varied. During the Cold War, the Red Sea region was politically charged and much of the littoral was off limits. Also, unlike Mediterranean shores with its vegetation, resources, and European nature, those of the Red Sea are deserts with few amenities. With underwater research difficult by its very nature, the added logistics of launching investigations on the Red Sea can be financially and practically prohibitive. Thus, while perhaps two dozen ancient shipwrecks have been reported and in a number of cases surveyed by archaeologists—many of these are in Egyptian waters¹—only four wrecks have been the subject of archaeological excavation. These are the seventeenth-century wreck at Sharm el-Sheikh, containing Ottoman pottery;² the sixteenth-century mercury carrier, also near Sharm el-Sheikh;³

¹ For example see L. Blue, J.D. Hill, and R. I. Thomas, “New Light on the Vessels of Indo-Roman Trade: Roman Period Shipwrecks in the Northern Red Sea,” in *Red Sea V - Navigated Spaces, Connected Places*, ed. Dionisius A. Agius, J. Cooper, and C. Zazzaro (British Archaeological Reports International Series, Oxford: Archaeopress, 2012), 91–100.

² Avner Raban, “The Shipwreck at Sharm El Sheikh,” *Archaeology* 24 (1971): 146–155.

³ Avner Raban, “The Mercury Carrier from the Red Sea,” *The International Journal of Nautical Archaeology* 2, no. 1 (1973): 179–183. Nili Liphshitz, “Two Shipwrecks off South Sinai,” *Skyliis* 1 (2011): 106–107.

the eighteenth-century shipwreck at Egypt's Sadana Island, whose cargo included Islamic-period ceramics, spices, and Chinese porcelain;⁴ and the mid-first-millennium wreck at Black Assarca Island, Eritrea.⁵



Figure 1. The Red Sea with the pertinent mentioned sites.

⁴ Cheryl Haldane, "Sadana Island Shipwreck, Egypt: Preliminary Report," *The International Journal of Nautical Archaeology* 25, no. 2 (May 1996): 83–94; Cheryl Haldane, "The Sadana Island Shipwreck Excavation: Final Season," *INA Quarterly* 25, no. 3 (1998): 3–5; Douglas Haldane, "The Logistics of the Sadana Island Shipwreck Excavation," *INA Quarterly* 25, no. 3 (1998): 6; Cheryl Ward, "The Sadana Island Shipwreck," *Saudi Aramco World* 51, no. 6 (2000): 14–21; Cheryl Ward, "The Sadana Island Shipwreck: An Eighteenth-Century AD Merchantman off the Red Sea Coast of Egypt," *World Archaeology* 32, no. 3 (2001): 368–382; Kathy Braun, "A Cargo of Islamic Ceramics From the Eighteenth-Century Sadana Island Shipwreck in the Red Sea: Form and Function of Qulal and Other Shapes" (Florida State University, 2005).

⁵ Ralph K. Pedersen, "Under the Erythraean Sea: An Ancient Shipwreck in Eritrea," *The INA Quarterly* 27, no. 2/3 (2000): 3–12; Ralph K. Pedersen, "The Byzantine-Aksumite Period Shipwreck at Black Assarca Island, Eritrea," *Azania* 43 (2008): 77–94; Lucy Blue, "The Red Sea," in *The Oxford Handbook of Maritime Archaeology*, ed. Alexis Catsambis, Ben Ford, and Donny L. Hamilton (Oxford: Oxford University Press, 2011), 495–512.

The Wreck at Black Assarca Island

This ship came to rest on the seabed off a desert island in the middle of the Massawa Channel, between the Buri Peninsula and Dahlak Kebir, probably sometime in the fifth or sixth century, a relative date based on the amphora types. The ship apparently struck the reef surrounding Black Assarca, as evidenced in the breakage of the ceramics found.

Found by tourists, the site was archaeologically surveyed in 1995, and in 1997 the Institute of Nautical Archaeology launched an excavation under my direction. The project was particularly important as no other Red Sea shipwreck from antiquity, *i.e.*, pre-Islamic times, had been the subject of archaeological excavation: The opportunity to find physical evidence of a ship and its cargo otherwise only known through texts of the period was unique. Indeed, nearly 18 years on the wreck at Black Assarca is still the only ancient one to be excavated in the entire Red Sea.

During the 1995 survey, only a few broken amphoras were seen on the seabed. Upon excavation, many more such vessels were found, all but one broken into pieces. Beneath the sand layer containing many ceramic sherds was a dead coral layer consisting of large and heavy chunks. When these were removed, even more amphoras were found. A number of these lay side by side, exhibiting hairline fractures, but retaining their shapes. This yields the potential that underneath these vessels parts of the wooden hull may exist.



Figure 2. Surveying in 1995 at Black Assarca Island with excavation in 1997.

The amphoras are of a type that came to be known by the mid-1990s as “Ayla-Axum” amphoras, named after their geographically extreme find-spots in the Red Sea region with Ayla being Byzantine-era Aqaba. The discovery of kilns at Aqaba, however, indicated that Ayla was the origin point of the type. This conclusion was validated by an archaeometric study of the fabric composition of various amphora finds around the sea,⁶ and the vessels have since been rechristened “Aqaba Amphoras.” Over 50 large segments of the amphoras and many sherds were excavated in 1997, with one intact amphora found, and it is estimated that at least that many remain within the site, whose excavation has yet to be completed. The type of amphora is conical, or carrot-shaped, with a spiral “rilling” on the body that is typical of many ceramics of the Byzantine period.

⁶ Michael M. Raith, et al., “The View from Zafar- An Archaeometric Study of the 'Aqaba Pottery Complex and Its Distribution in the 1st Millennium CE,” *Zeitschrift Für Orient-Archäologie* 6 (2013): 318–348.



Figure 3. Amphoras and sherds on site.



Figure 4. A Selection of Amphoras from the wreck.

A second type of amphora was also found but limited to the wreck's central area. These are globular containers known as costrels. All examples of these were broken, but the number of costrels was clearly fewer than that of the conical ones. This indicates that not only was a different liquid or foodstuff being transported in them, but perhaps also a better quality or more costly one.

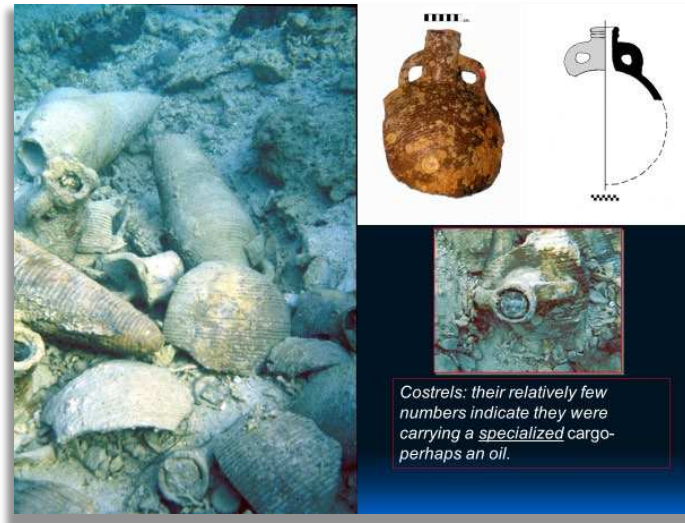


Figure 5. Costrels.

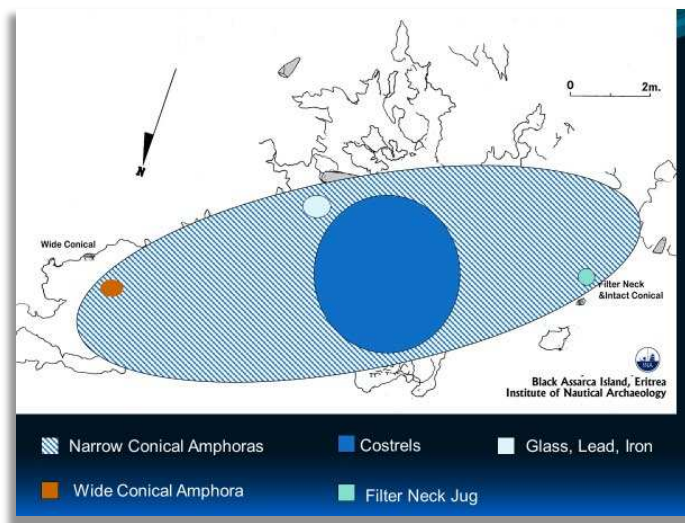


Figure 6. Distribution of amphora types.

Aside from the two amphora types, a single example of a wide-body conical amphora was found toward the east end of the site.⁷ Toward the western end a filter neck from a jug was found,⁸ which bears similarity to ones found at Adulis.⁹ In addition, in the central part of the site a section of the base of a glass goblet or wineglass was found. Nearly adjacent to this was a lead steelyard counterweight of a globular, or ball-like, Byzantine style.¹⁰

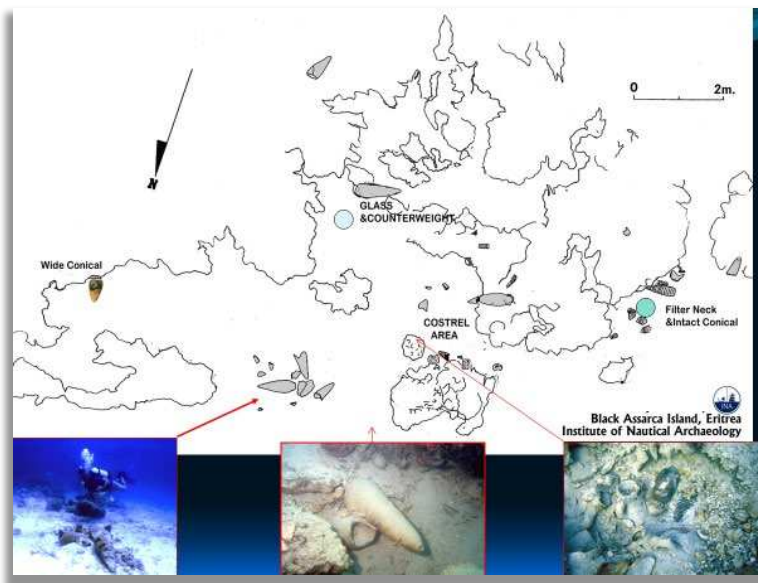


Figure 7. A site plan of the shipwreck.

⁷ Pedersen, "Under the Erythraean Sea: An Ancient Shipwreck in Eritrea," 10-11.

⁸ Pedersen, "The Byzantine-Aksumite Period Shipwreck at Black Assarca Island, Eritrea," 87.

⁹ Chiara Zazzaro, "Adulis and the Eritrean Coast in the Museum Collections and Italian and Other European Traveller's Accounts," in *Connected Hinterlands. Proceedings of the Red Sea Project IV, Held at the University of Southampton, September 2008. BAR International Series 2052*, ed. Lucy Blue et al. (Oxford: Archaeopress, 2009), 51, fig. 6:5b.

¹⁰ Pedersen, "Under the Erythraean Sea: An Ancient Shipwreck in Eritrea," 11.

The wreck at Black Assarca is not unique to Eritrea. Two others are reported, one of which contains amphoras similar to those of Black Assarca. These, however, await confirmation of their natures and investigation.



Figure 8. Amphora sherds from another site in Eritrean seas.

Over the past century, Aqaba amphoras have been found at a number of sites. They have been found in their highest concentration in the Red Sea region at harbors such as Berenike and Adulis, as well as around their origin point in Jordan and at one of their main termini, the Aksumite kingdom centered on its capital Aksum, now in Ethiopia.¹¹ Other examples have been found in Yemen, notably at Zafar,¹² and some examples occur on the northwestern coast of India. One far-flung example was found on a late sixth-century shipwreck at Iskandil Burnu, Turkey,¹³ which is

¹¹ Raith, et al., “The View from Zafar- An Archaeometric Study of the ‘Aqaba Pottery Complex and Its Distribution in the 1st Millennium CE.”

¹² Kristina A. Franke, et al., “Zafār, Capital of Himyar. Sixth Preliminary Report, February-March 2006,” *Zeitschrift Für Orient-Archäologie* 1 (2008): plate 4, nos. 4, 5.

¹³ Manuela Lloyd, “A Byzantine Shipwreck at Iskandil Burnu, Turkey: Preliminary Report” (Texas A&M University, 1984); Manuela Lloyd, “The Shipwreck at Iskandil Burnu,” *INA Newsletter* 12, no. 3 (n.d.): 4–5.

something of an anomaly as the amphoras were clearly being produced to ship wine, or possibly foodstuffs such as the fish-sauce known as garum,¹⁴ down the Red Sea.

Investigations along the Arabian Coast near Jeddah, 2012-2013

In March 2012 the archaeology seminar at Philipps-Universität Marburg fielded a research team in conjunction with the Saudi Commission for Tourism and Antiquities to conduct preliminary archaeological investigations along the Arabian coast in the vicinity of Jeddah. While most of the 12 days were devoted to exploring the underwater realm, the team spent a few days examining lagoonal zones at Rabigh and Al-Shu'ayba at either end of the 200-kilometer research zone.

Along the southern edge of the lagoon Khor al Kharrar, close to the town of Rabigh, a coral-built jetty was found in conjunction with small mollusk-shell middens and fire pits. No artifacts were associated with these finds so a date could not be determined. The jetty, 24 meters long, apparently once served local fishing craft, but now was on dry land at low tide perhaps indicating changes in sea levels or the siltation build up since its construction.

¹⁴ Emanuele Casagrande Cicci, "Ayla-Axum Amphorae Through the Red Sea Regions and the Arabian Peninsula During the Medieval Age," *History Research* 2, no. 7 (2012): 467–475. Wim Van Neer and S. Thomas Parker, "First Archaeozoological Evidence for Himation, the 'invisible' Garum," *Journal of Archaeological Science* 35, no. 7 (July 2008): 1821–1827. Cicci (471-2), it should be noted, interprets the finding of eggs in the intact amphora at Black Assarca as evidence of garum. The eggs were, in fact, octopus ova, consisting solely of their casings. It is not unusual in underwater archaeology to find amphoras that have been inhabited by octopi as the jars make excellent nests, as noted by Deborah Carlson, "The Classical Greek Shipwreck at Tektas Burnu, Turkey," *American Journal of Archaeology* 104, no. 4 (January 2003): 592. This is the case with the amphora from Black Assarca: there is no evidence for garum transport at Black Assarca and the ova casings should not be interpreted as such.



Figure 9. The jetty at Khor al Kharrar and associated features.

At the opposite end of our research zone is the area believed to be Al-Shu’ayba, the pre-Islamic and early-Islamic harbor for Mecca. A tradition that dates as early as the third century A.H/Ninth Century A.C. states that Al-Shu’ayba was abandoned by command of ‘Uthmān in favor of Jeddah.¹⁵ While the actual harbor has yet to be located, a small number reported shipwrecks at Al-Shu’ayba testify to its past importance. Among these wrecks is the ‘Silver Coin Wreck,’ a 13th-century coin-carrying ship that was looted in the 1990s. The offering of the coins for sale in the United States brought the artifacts to the attention of authorities, and in 2006 the coins were returned to Saudi Arabia and ultimately displayed in the National Museum in Riyadh.

¹⁵ Gerald R. Hawting, “The Origin of Jedda and the Problem of Al-Shu’ayba,” *Arabica* 31, no. 3 (1984): 318–326.

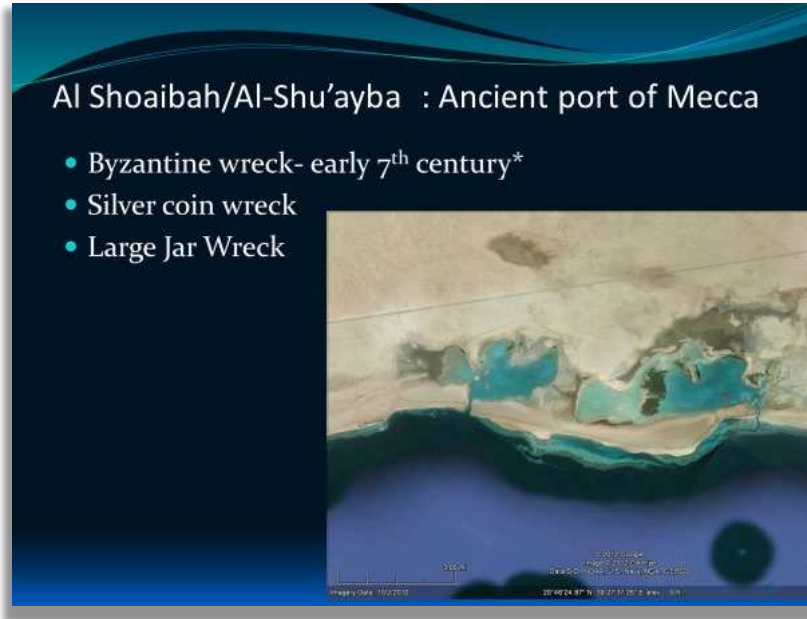


Figure 10. The supposed ancient harbor site.



Figure 11. The display of the Coin Wreck.

Jeddah Wreck I

At sea, the Marburg team spent several days engaged in underwater exploration in the Eliza Shoals, a shallow area of reefs on the northern approaches to Jeddah. On our second day of underwater survey, our dive master, Gerd Knepel, found a large sherd consisting of an amphora top protruding from the seabed. The sherd, lying partially buried but loose, was raised for diagnostic purposes, and has been tentatively identified as perhaps belonging to a type of Dressel 24 or Late Roman 2 amphora. These types of jar are characterized by heavy, arching handles set high on the shoulder and curving into the base of the neck or high shoulder, depending on the type or style variations. Nine or ten bands of riling on the shoulder along with a funnel-shaped mouth further indicate a relation to these circa fourth/fifth-century types.¹⁶ While these amphora types are recognized as wine transport vessels, some examples have been found in the Aegean with the dipinto “*oleum*” written on them indicating that at least some of the jars were used for oil—probably olive oil—transport.¹⁷ This makes the find possibly the first subaquatic archaeological evidence from the Saudi coast of trade in oil from the Mediterranean zone, yet further analysis is most certainly needed.

¹⁶ Andrei Opait, “From DR 24 to LR 2?,” in *LRCW2 Late Roman Coarse Wares, Cooking Wares and Amphorae in the Mediterranean Archaeology and Archaeometry. BAR International Series 1662 (II)*, ed. Michel Bonifay and J. Treglia, vol. II (Oxford: Archaeopress, 2007), 632.

¹⁷ *Ibid*, 633.

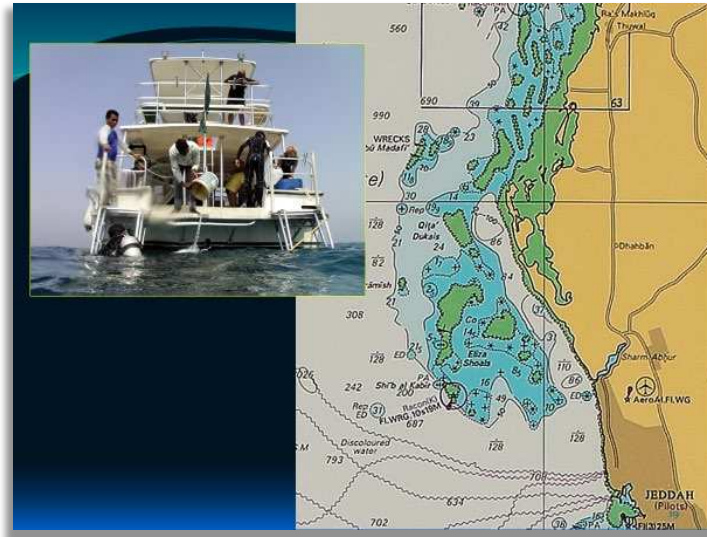


Figure 12. A map of the Eliza Shoals area and our research vessel.



Figure 13. The Amphora top. Jeddah Wreck I.

A second amphora type was found concreted into the seabed. Thus, its base and whole form could not be seen. Handle stubs on the shoulder indicated they are of a similar size if not style as on the previously mentioned amphora top. This indicates that both amphoras have a similar origin in time,

if not location,¹⁸ and that they belong to one single event, that is, the same shipwreck, as opposed to jettison from differing ships at differing times.

A notable feature on this amphora is a small hole in its neck, which leads directly to the identification of the original contents and function.¹⁹ This is a secondary fermentation lock, or vent, necessary for the storing or shipping of new or young wine as such liquids can release gasses from renewed or unfinished fermentation. This small hole was sealable with wet clay that could be opened up to permit the release of gasses, or could be allowed to ‘blow out’ on its own.²⁰ Such locks are “commonly found”²¹ on wine amphoras of varying styles and sizes from Egypt—dating from the Bronze Age into the Roman period—and even from Sudan in the thirteenth century. Venting holes are also found on Palestinian Late Roman 4 (LR4) and Late Roman 5 (LR5) wares, but on the shoulder. Thus, with this find, we have the physical evidence for the transport of new or young wine into Arabia, or at least along the coast, in the Roman period.²²

¹⁸ The type seems to be manufactured in Greece or the Peloponnesus, but the general DR 24 class may have a wider geographical production range as at least one fragment has been found at Hisarönü, near Cnidos in Anatolia. See Ibid, 629, 632; and Jean-Yves Empereur and Numan Tuma, “Hiérotélès, Potier Rhodien de La Pérée,” *Bulletin de Correspondance Hellénique* 113, no. 1 (1989): 285-286, fig. 14b.

¹⁹ William Y. Adams, “The Vintage of Nubia,” *Kush* XIV (1966): 281, n. 99; and 282 wherein Adams writes that the hole in the necks of amphoras are “a certain indication that these vessels were actually used for fermentation.”

²⁰ Amphora stoppers could also be equipped with a venting hole. See A. Lucas, “Alcoholic Beverages,” in *Ancient Egyptian Materials and Industries*, 2nd ed. (London: Edward Arnold & Co., 1934), 17.

²¹ Adams, “The Vintage of Nubia.” 282, n. 108.

²² Ibid. 283, where Adams reports that several amphoras for wine that were made locally at the Monastery of Meinarti in Nubia in a 13th century context exhibit holes in their necks. See Sean A. Kingsley, “Late Antique Trade: Research Methodologies and Field Practices,” in *Theory and Practice in Late Antique Archaeology*, ed. L. Lavan and W Bowden (Leiden: Brill, 2003), 128; Sean A. Kingsley, “The Dor D Shipwreck and Holy Land Wine Trade,” *The International Journal of Nautical Archaeology* 32, no. 1 (August 2003): 88.

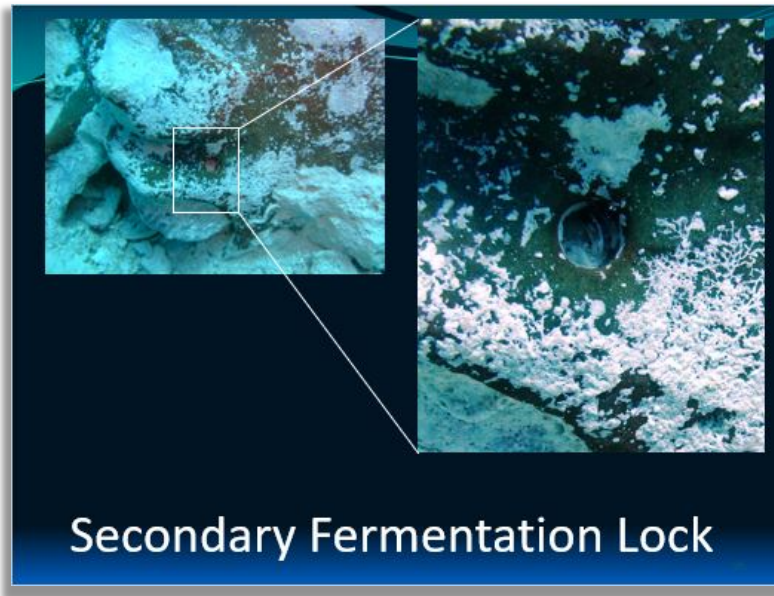


Figure 14. The hole in the amphora neck for the release of fermentation gasses.

The other class of artifact found were several stone blocks scattered around the reef near the location of the amphoras. These were rectangular, but at least one was semi-circular in cross-section. The type of stone is unknown.

In 2013, on our second survey at Jeddah, another section of an amphora similar to the amphora top was found in the sand at the base of the reef. Thus, we have a small collection of ceramics sharing at least some characteristics, indicating a contemporaneous origin for them if not a geographical one. The nature of the artifacts indicates that a maritime accident occurred at the reef. Where the ship's ultimate resting place may be is yet unknown. It is possible that more material lies under the hard layer of dead coral, masking the main body of the wreck.

Jeddah Wreck II

In addition to the Roman find at the reef, another site was located by three of my Marburg archaeology students²³ while surveying along the reef where the Roman amphoras were found. One of the students, Matthias “Matze” Link spotted ceramics on the sea floor. His initial description indicated a scattering of vessels similar to Aqaba ware, with perhaps as many as a couple of dozen visible, as formal investigation of the site later confirmed. Several conical amphoras, along with other ceramic forms, lay around the seabed in no discernible pattern. At least one amphora exhibited the rilling typical of Aqaba amphoras. While no toe button was readily seen on this, it is possible it was severely worn or broken off, or it may be simply a variant in style as does occur. The style of the decoration, the shape, and the thickness of the fabric are all matches for the Aqaba type. Further examination of the site is needed to refine its nature and extent of the shipwreck’s remains.



Figure 15. The site Jeddah Wreck II, with views of an Aqaba amphora.

²³ Eugen Maier, Matthias Link, and Bernhard Klotz.

Potential for East Africa and Discovery of Chinese Shipwrecks

As with the Red Sea, there are relatively few archaeologically investigated wrecks in the Indian Ocean, their number are only around two dozen.²⁴ Perhaps foremost among these are the *Santa António de Tanná*, a Portuguese wreck at Fort Jesus, Mombasa, Kenya;²⁵ the 1000-year-old Kadakkarapally Boat in Kerala, India;²⁶ a first-century BC wreck in Sri Lanka;²⁷ the wreck of *Princes Royal* in India;²⁸ *Serapis*, the ship of John Paul Jones lying off Madagascar;²⁹ a Portuguese wreck in Mauritius; and another Portuguese wreck in Goa.³⁰

²⁴ For a recent compendium of western Indian Ocean wrecks, see Paul J. Lane, “Maritime and Shipwreck Archaeology in the Western Indian Ocean and the Southern Red Sea: Past and Current Research,” *Journal of Maritime Archaeology* 7 (2012): 9–41.

²⁵ Robin C. M. Piercy, “Mombasa Wreck Excavation: Preliminary Report 1977,” *The International Journal of Nautical Archaeology* 6, no. 4 (1977): 331–347; Paul J. Lane, “Maritime and Shipwreck Archaeology in the Western Indian Ocean and the Southern Red Sea: Past and Current Research,” *Journal of Maritime Archaeology* 7 (2012): 10–14.

²⁶ Ralph K. Pedersen, “The Shipwreck in a Coconut Grove: The Kadakkarapally Boat,” *The INA Quarterly* 31, no. 2 (2004): 3–9; Victoria Tomalin et al., “The Thaikkal-Kadakkarpally Boat: An Archaeological Boat: An Archaeological Example of Medieval Shipbuilding in the Western Indian Ocean,” *The International Journal of Nautical Archaeology* 33, no. 2 (2004): 253–263.

²⁷ Andrew Lawler, “Seafaring in Ancient Sri Lanka,” *Archaeology*, 2014.

²⁸ Alok Tripathi, “Princes Royal – Excavation of Ancient Shipwreck in the Arabian Sea,” *Current Science* 86, no. 9 (2004): 1246–1250.

²⁹ Michael C Tuttle et al., *2008 Diver Investigations of the Suspected Serapis Site Ambodifototra, Isle Ste Marie, Madagascar*, 2010.

³⁰ Sila Tripathi and A S Gaur, *Exploration of a Portuguese Shipwreck in Goa Waters, Western Coast of India*, 2004.



Figure 16. Excavated shipwrecks around the western Indian Ocean. Image from Google Earth.

Remote-sensing surveys in 2001 by the University of Ulster and the British Institute in East Africa revealed several late shipwrecks off the Kenyan coast as well as a number of anomalies, showing the promise of such endeavors.³¹ Additionally, similar surveys by a commercial company in Mozambique have yielded evidence of a number of shipwrecks, one of was the *Espardarte*, which carried a cargo of sixteenth-century Chinese porcelain.³²

Clearly, shipwrecks exist along the African coast, and they can be located and studied. Many of these appear to be from the European contact and hegemonic periods, perhaps testifying to the amount of maritime activity conducted by the Portuguese and others after the rounding of the Cape

³¹ Colin Breen and Paul Lane, “Archaeological Approaches to East Africa’s Changing Seascapes,” *World Archaeology* 35, no. 3 (2004): 481.

³² Lane, “Maritime and Shipwreck Archaeology in the Western Indian Ocean and the Southern Red Sea: Past and Current Research,” 17-19.

of Good Hope by Vasco da Gama. Chinese vessels have yet to be discovered, however. There have been reports of the wreck of one such off Pate Island, but a joint Chinese-Kenyan effort to locate the site has yielded no reported results to date.³³

If we are to locate Chinese ships off Africa, as is a focus of discussion of the Addis Ababa conference, we need to firstly and foremost delineate the harbors and anchorages of the terminal points of African-Chinese exchange, that is, where would a Chinese vessel have made landfall along the African coast? Which sailing routes would a navigator have chosen, and which danger areas would a ship have encountered are also considerations for finding these theorized ships. We must also keep in mind that it may not have been necessary for a Chinese ship to sail directly to Africa to acquire African trade items. It is quite possible that India and Sri Lanka served as trading hubs between east and west, as the subcontinent did in Roman times, thereby making a complete journey to the African coast unnecessary for some circumstances. Such would limit the number of Chinese ships that could potentially wreck in the western Indian Ocean area, further diminishing chances of finding Chinese wrecks in Africa.

Yet, it is worth the search. Archaeology always turns up surprises, and the unexpected. The coast of Africa should be no different. Chinese wrecks may well exist there. We only have to look, conduct surveys under sea by visual and remote-sensing means using scuba and tools such as Side Scan Sonar/Multi-beam sonar to map harbor beds, and find shipwrecks. On land, LIDAR (light imaging direction and radar) and aerial photography can be used to find ancient harbors as well as delimit coastal features used in navigation.

³³ Ibid. 15.

Bibliography

- Adams, William Y. "The Vintage of Nubia." *Kush* XIV (1966): 262–283.
- Blue, L., J.D. Hill, and R. I. Thomas. "New Light on the Vessels of Indo-Roman Trade: Roman Period Shipwrecks in the Northern Red Sea." In *Red Sea V - Navigated Spaces, Connected Places*, edited by Dionisius A. Agius, J. Cooper, and C. Zazzaro, 91–100. British Archaeological Reports International Series, Oxford: Archaeopress, 2012.
- Blue, Lucy. "The Red Sea." In *The Oxford Handbook of Maritime Archaeology*, edited by Alexis Catsambis, Ben Ford, and Donny L. Hamilton, 495–512. Oxford: Oxford University Press, 2011.
- Braun, Kathy. "A Cargo of Islamic Ceramics From the Eighteenth-Century Sadana Island Shipwreck in the Red Sea: Form and Function of Qulal and Other Shapes." Florida State University, 2005.
- Breen, Colin, and Paul Lane. "Archaeological Approaches to East Africa's Changing Seasapes." *World Archaeology* 35, no. 3 (2004): 469–489.
- Carlson, Deborah. "The Classical Greek Shipwreck at Tektas Burnu, Turkey." *American Journal of Archaeology* 104, no. 4 (January 2003): 581–600.
- Cicci, Emanuele Casagrande. "Ayla-Axum Amphorae Through the Red Sea Regions and the Arabian Peninsula During the Medieval Age." *History Research* 2, no. 7 (2012): 467–475.
- Empereur, Jean-Yves, and Numan Tuma. "Hiérotélès, Potier Rhodien de La Pérée." *Bulletin de Correspondance Hellénique* 113, no. 1 (1989): 277–299.
- Franke, Kristina A, Manfred Rösch, Cornelia Ruppert, and Paul Yule. "Zafār, Capital of Himyar. Sixth Preliminary Report, February-March 2006." *Zeitschrift Für Orient-Archäologie* 1 (2008): 208–245.
- Haldane, Cheryl. "Sadana Island Shipwreck, Egypt: Preliminary Report." *The International Journal of Nautical Archaeology* 25, no. 2 (May 1996): 83–94.
- . "The Sadana Island Shipwreck Excavation: Final Season." *INA Quarterly* 25, no. 3 (1998): 3–5.
- Haldane, Douglas. "The Logistics of the Sadana Island Shipwreck Excavation." *INA Quarterly* 25, no. 3 (1998): 6.

- Hawting, Gerald R. "The Origin of Jeddah and the Problem of Al-Shu'ayba." *Arabica* 31, no. 3 (1984): 318–326.
- Kingsley, Sean A. "Late Antique Trade: Research Methodologies and Field Practices." In *Theory and Practice in Late Antique Archaeology*, edited by L. Lavan and W. Bowden, 113–138. Leiden: Brill, 2003.
- . "The Dor D Shipwreck and Holy Land Wine Trade." *The International Journal of Nautical Archaeology* 32, no. 1 (August 2003): 85–90.
- Lane, Paul J. "Maritime and Shipwreck Archaeology in the Western Indian Ocean and the Southern Red Sea: Past and Current Research." *Journal of Maritime Archaeology* 7 (2012): 9–41.
- Lawler, Andrew. "Seafaring in Ancient Sri Lanka." *Archaeology*, 2014.
- Lipshitz, Nili. "Two Shipwrecks off South Sinai." *Skyllis* 1 (2011): 106–107.
- Lloyd, Manuela. "A Byzantine Shipwreck at Iskandil Burnu, Turkey: Preliminary Report." Texas A&M University, 1984.
- . "The Shipwreck at Iskandil Burnu." *INA Newsletter* 12, no. 3 (n.d.): 4–5.
- Lucas, A. "Alcoholic Beverages." In *Ancient Egyptian Materials and Industries*, 5–27. 2nd ed. London: Edward Arnold & Co., 1934.
- Opait, Andrei. "From DR 24 to LR 2?" In *LRCW2 Late Roman Coarse Wares, Cooking Wares and Amphorae in the Mediterranean Archaeology and Archaeometry. BAR International Series 1662 (II)*, edited by Michel Bonifay and J. Treglia, II:627–643. Oxford: Archaeopress, 2007.
- Pedersen, Ralph K. "The Byzantine-Aksumite Period Shipwreck at Black Assarca Island, Eritrea." *Azania* 43 (2008): 77–94.
- . "The Shipwreck in a Coconut Grove: The Kadakkarapally Boat." *The INA Quarterly* 31, no. 2 (2004): 3–9.
- . "Under the Erythraean Sea: An Ancient Shipwreck in Eritrea." *The INA Quarterly* 27, no. 2/3 (2000): 3–12.
- Piercy, Robin C. M. "Mombasa Wreck Excavation: Preliminary Report 1977." *The International Journal of Nautical Archaeology* 6, no. 4 (1977): 331–347.
- Raban, Avner. "The Mercury Carrier from the Red Sea." *The International Journal of Nautical Archaeology* 2, no. 1 (1973): 179–183.

- . “The Shipwreck at Sharm El Sheikh.” *Archaeology* 24 (1971): 146–155.
- Raith, Michael M., Radegund Hoffbauer, Harald Euler, Paul A. Yule, and Kristoffer Damgaard. “The View from Zafar- An Archaeometric Study of the 'Aqaba Pottery Complex and Its Distribution in the 1st Millennium CE.” *Zeitschrift Für Orient-Archäologie* 6 (2013): 318–348.
- Tomalin, Victoria, V. Selvakumar, M. V. Nair, and P. K. Gopi. “The Thaikkal-Kadakkappally Boat : An Archaeological Boat: An Archaeological Example of Medieval Shipbuilding in the Western Indian Ocean.” *The International Journal of Nautical Archaeology* 33, no. 2 (2004): 253–263.
- Tripathi, Alok. “Princes Royal – Excavation of Ancient Shipwreck in the Arabian Sea.” *Current Science* 86, no. 9 (2004): 1246–1250.
- Tripathi, Sila, and A S Gaur. *Exploration of a Portuguese Shipwreck in Goa Waters, Western Coast of India*, 2004.
- Tuttle, Michael C, Norine Carroll, Kelly Bumpass, Michael Krivor, and Jason Burns. *2008 Diver Investigations of the Suspected Serapis Site Ambodifototra, Isle Ste Marie, Madagascar*, 2010.
- Van Neer, Wim, and S. Thomas Parker. “First Archaeozoological Evidence for Himation, the ‘invisible’ Garum.” *Journal of Archaeological Science* 35, no. 7 (July 2008): 1821–1827.
- Ward, Cheryl. “The Sadana Island Shipwreck.” *Saudi Aramco World* 51, no. 6 (2000): 14–21.
- . “The Sadana Island Shipwreck: An Eighteenth-Century AD Merchantman off the Red Sea Coast of Egypt.” *World Archaeology* 32, no. 3 (2001): 368–382.
- Zazzaro, Chiara. “Adulis and the Eritrean Coast in the Museum Collections and Italian and Other European Traveller’s Accounts.” In *Connected Hinterlands. Proceedings of the Red Sea Project IV, Held at the University of Southampton, September 2008. BAR International Series 2052*, edited by Lucy Blue, John Cooper, Ross I. Thomas, and Julian Whitewright, 49– 59. Oxford: Archaeopress, 2009.

All images copyright
by the author and/or Marburg Project.

For reproduction permission, contact the author.

Citation information:

Ralph K. Pedersen. (2014). “Shipwreck Archaeology in the Red Sea and the Potential of Exploration along the East African Littoral.” Proceedings of the conference *Exploring China’s Ancient Links to Africa. Addis Ababa, October 29-31, 2014.*
Plus, relevant url.

