



AMERICAN JOURNAL OF ARCHAEOLOGY

656 Beacon Street, Boston, MA 02215 • Tel.: 617-353-9361 • www.ajaonline.org

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www.jstor.org/stable/10.3764/aja.119.1.0125.

Volume 119, Number 1
January 2015

AMERICAN JOURNAL OF ARCHAEOLOGY

The Journal of the Archaeological Institute of America



www.ajaonline.org

A Preliminary Report on a Coastal and Underwater Survey in the Area of Jeddah, Saudi Arabia

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In March 2012, Philipps-Universität Marburg conducted a 12-day survey along a section of the Red Sea coast of Saudi Arabia reaching from Rabigh in the north to al-Shoaiba in the south. As the beginning of a five-year archaeological project, this preliminary venture sought to define the logistical situation and to discover any sites of archaeological importance that may exist within the zone. The survey included the search for and the examination of harbor sites, as well as shipwrecks. Sites of antiquity and the Early Islamic period were of particular interest. The results of the survey included the discovery of a harbor and a shipwreck of the late third or the fourth century that contained Roman amphoras, among other objects.*

INTRODUCTION

With the signing of a five-year agreement with the Saudi Commission for Tourism and Antiquities (SCTA), a team of archaeologists and other specialists from Philipps-Universität Marburg conducted a two-week preliminary survey along the central coast of Saudi Arabia.¹ The region, which reaches from Rabigh south to al-Shoaiba,² a distance of some 200 km, has been little explored. There have been few archaeological investigations along this coast and certainly none under the sea. The preliminary survey examined select areas at the extremities of the research zone and several underwater locations off the coast of Jeddah in the Eliza Shoals. The goals were to ascertain the logistics for a long-term investigation and to make preliminary discoveries that could demonstrate the research potential of the area.

THE STATE OF NAUTICAL AND COASTAL ARCHAEOLOGY IN THE KINGDOM OF SAUDI ARABIA

Coastal archaeology and nautical archaeology in the Kingdom of Saudi Arabia are in their infancy. There have apparently been few archaeological underwater investigations prior to the survey in 2012. There have, however,

*The team is grateful to His Royal Highness Prince Sultan bin Salman bin Abdul Aziz, president of the Saudi Commission for Tourism and Antiquities (SCTA), for his support and the opportunity to conduct our research in the kingdom. We also thank Ali Al-Ghabban, vice president of the SCTA; Said Al-Said, King Saud University; Jamal Omar, head of research and excavations, and the staff of the SCTA; and Eric Mason and the staff of Dream Divers. I extend my gratitude to the two anonymous reviewers for the *AJA*. Figures are my own unless otherwise noted.

¹The team included the author as principal investigator; Rupert A. Brandmeier, project manager; Gerd Knepel, dive master; Jesper Wangen, doctoral student and ceramics specialist; and Winfried Held, university administrator. The project was joined by personnel from the SCTA, including Ammar Abdul Kareem Alsewan, Ibrahim O. Aldhwyani, Abdullah S. Al-Haiti, Mahdi K. Alqarni, Fares Mohammed Hamzi, and Khalaf Jalawi Al Hamad.

²Al-Shoaiba has varying spellings (as do other sites mentioned in this article), including but not limited to “al-Shu‘ayba” and “Shuaiba” (Awari and Mullah 2010).

been some terrestrial coastal examinations, primarily north of the research area (fig. 1).³

Few harbors of the ancient Red Sea coast of what is now Saudi Arabia are mentioned in classical literature; scholars debate the locations of those that are mentioned, such as Iotabê, which may be equated with Tiran Island at the mouth of the Gulf of Aqaba.⁴ Another northern ancient harbor whose location is unknown is Leuke Kome, the primary port of the Nabataeans.⁵ This port has been placed anywhere from Khuraybah to Yanbu.⁶ The former is a strong candidate, lying as it does at the head of the Red Sea and on the land route to Petra.⁷ Musil, writing in the early 20th century, may have made the first archaeological observations concerning the location of this port at Khuraybah.⁸

South from Khuraybah is al-Wedjh, which has been recognized since at least the 19th century as the “Egra” of Strabo (16.4.24), although there seems to be no archaeological evidence that supports this identification.⁹ The name of the port is related to the inland city of Hegra (el-Hijr). It may have been a usual practice to call a port after its accompanying city.¹⁰ In considering whether al-Wedjh (also spelled “el-Wijh”) was the site of the seaport of el-Hijr, Burton, who excavated at Midian in the 1870s, stated that “El-Wijh is still the main, indeed the only, harbour in South Midian; and, during our stay there, a large caravan brought goods . . . from the upper Wady Hamz.”¹¹ Al-Wedjh is also a leading candidate for the location of Leuke Kome because of its location opposite Myos Hormos.¹²

Farther south are a series of harbors that were surveyed in the late 1970s or early 1980s.¹³ These contained artifacts of Nabataean and Islamic origin along with such features as coral-block foundations.¹⁴ These harbors include al-Hawra, which Burton equates with Leuke Kome and at which some archaeological trenches were dug in the early 1980s;¹⁵ Bar Antar, located on a small inlet north of al-Wedjh and containing many artifacts and coral-built buildings; and al-Sawrah, located between Bar Antar and Khuraybah and containing



FIG. 1. A map of the Red Sea, showing key sites mentioned in the text.

coral-built walls, beads, iron slag, lithics, glass, bronze objects, and Nabataean pottery.¹⁶ Also found along this coast were the Early Islamic harbors of the pilgrimage routes. These include the previously mentioned al-Hawra; al-Dogm, located north of Umm Lejj; and al-Jār at the Bay of Buraykah, where sondages were made in the early 1980s and in 2002.¹⁷ Al-Jār, located on both an island and the mainland, is the former port for Medina and contains “several buildings and

³South of the survey zone, most research has been done in the Farasān Islands. Investigations there have centered on paleocoastlines (Bailey et al. 2007); ethnographic research, during which a stone anchor was found at Wadi Matar (Cooper and Zazzaro 2012, 408); and epigraphy (de Procé and Phillips 2010).

⁴The geography and marine conditions argue against this determination (Mayerson 1992, 3; 1995).

⁵Nappo 2010.

⁶Nappo (2010) believes al-Wedjh has a better claim based in large part on an analysis of the sailing distances in Strabo and the *Periplus Maris Erythraei*.

⁷Sidebotham 1986, 125–26; Tomber 2004, 396.

⁸Musil 1926. Ingraham et al. (1981) conducted some exca-

vations at nearby Aynunah in the early 1980s, but the harbor area appears to have received little attention.

⁹Nappo (2010, 340–42) places Egra at the inland city of Mada’in Saleh (ancient Hegra), despite what Strabo records. Additionally, Sprenger (1875, 38) suggests ancient Egra was in the vicinity of Rabigh.

¹⁰Burton 1879; Musil 1926, 299.

¹¹Burton 1879, 107.

¹²Durand 2012, 88.

¹³Al-Mughannam et al. 1983.

¹⁴Ingraham et al. 1981, 78.

¹⁵Power 2012, 139.

¹⁶Ingraham et al. 1981.

¹⁷Damgaard 2011, 169–71.

a wall with traces of wells and conduits leading to still intact water basins.”¹⁸ It played a crucial role in the aftermath of the famine of 634/5 when, after the Islamic conquest of Egypt, grain and supplies began to be brought from Egypt through Clysma to Medina via al-Jār.¹⁹ Apparently, ships of the international trade, including those from China, visited al-Jār over the next few centuries; the harbor continued to be the entrepôt for Egyptian grain until it was overtaken in importance by Jeddah and Yanbu.²⁰

Farther south is Yanbu with its *sharm* (narrow inlet or passage) and bay. This may be the location of Charmuthas, said by Agatharchides to be the best harbor on the coast. Agatharchides (quoted in Diod. Sic. 3.44.7–8) also noted its similarity to Carthage with its narrow entrance and central round island. Others, however, place Leuke Kome at Yanbu, with Charmuthas lying farther south,²¹ such as at the lagoon Khor al-Kharrar near Rabigh.²² Charmuthas is further associated with a triple-temple complex whose location remains undetermined.²³ Nevertheless, Yanbu contains one of the area’s more ancient cultural horizons. Hand axes of the Middle Acheulean tradition have been found on its shore, indicating its long attractiveness for coastal dwellers if not seafarers.²⁴

Several shipwrecks are known along the northwestern coast. These have been found by sport divers—thus, they are highly vulnerable to looting. One wreck, dating seemingly to the 18th century, was featured in the 2009 BBC program “The Frankincense Trail” and has subsequently been severely robbed.²⁵ The wrecks along the northwestern coast might be indicative of the volume of sea travel there. The area is, however, the zone most frequented by sport divers, which may account for the relative preponderance of shipwrecks in the region and the lack of known wrecks in other places less frequented by divers.

SAILING ROUTES AND CONDITIONS

Our knowledge of the sailing routes along the Red Sea Arabian coast in antiquity is limited. In the Medieval era, Ahmad Ibn Majid, the famed navigator, recorded the navigational practices for the Arabian Sea and Persian Gulf, but of the Red Sea and the areas north of the southern Red Sea he, and others of

his ilk, had little knowledge.²⁶ Nevertheless, Ibn Majid noted five routes: two were coastal routes between land and reefs along either side of the sea; one was the central deepwater route; and the last two involved hopping along the islands on both the Arabian and African sides.

The lack of detailed knowledge of the sailing routes is perhaps due to the linear nature of the Red Sea, which required little navigation aside from north-south reckoning, and to the desire of captains to stay in the middle of the sea to avoid the “treacherous banks and reefs near the coast.”²⁷ Even in Strabo’s (16.4.2) time, those banks were known to be sandy and barren. It is possible that most traffic crossed from the Nabataean region to Africa, as suggested by Nabataean graffiti in Egypt’s Eastern Desert near Myos Hormos.²⁸ Perhaps sailors preferred to sail the more frequented routes and the relatively more settled shores of Africa before recrossing to Arabia Felix. The anonymous author of the *Periplus Maris Erythraei* describes the situation of the Arabian coast south of the Nabataean lands thus (the harbor referenced in the first line is Leuke Kome):²⁹

Immediately after this harbor begins the country of Arabia, extending lengthwise far down the Erythraean Sea. . . . The coastal area is, similarly, marked by clusters of the mean huts of the Ichthyophagoi, while the area inland has villages and pasturages inhabited by people, speaking two languages, who are vicious: they plunder any who stray from a course down the middle and fall among them, and they enslave any who are rescued by them from shipwreck. . . . In fact, to set a course along the coast of Arabia is altogether risky, since the region with its lack of harbors offers poor anchorage, is foul with rocky stretches, cannot be approached because of cliffs, and is fearsome in every respect. This is why, when sailing down the sea, we set a course for Arabia down the middle and put on extra speed as far as Katakekaumene [“burnt”] Island.

Clearly, in at least the Roman period ships that were engaged in international trade ran the risk of notorious raiders hiding along the shores of the central Arabian coast. Little is known of these people beyond the scant knowledge imparted by the *Periplus Maris Erythraei*. The pirates appear to belong to disparate

¹⁸ Al-Mughannam et al. 1983, 46–8.

¹⁹ Hitti 1916, 340–41; Dietrich 1965, 454; Mayerson 1995, 34.

²⁰ Power 2012, 139.

²¹ Ingraham et al. 1981, 77–8.

²² Nalesini 2012, 79 n. 8.

²³ Nalesini 2012, 79.

²⁴ Zarins et al. 1982, 35–6.

²⁵ Information about the looting has been provided by sources in Jeddah.

²⁶ Tolmacheva 1980, 189.

²⁷ Tibbetts 1961, 323.

²⁸ Durand 2012, 87.

²⁹ *Periplus Maris Erythraei* 20 (translated by Casson 1989, 63 [brackets original]).

groups, unable to be controlled or to be absorbed into the neighboring Nabataean and Sabaeen cultures. As Casson states, the coast had “no central authority, being inhabited by primitive fisherfolk and herdsmen; the latter eked out their meager livelihood with the profitable returns from piracy.”³⁰ The coastal people were quite adept at their calling, and according to Pliny (*HN*6.101) they posed a problem grave enough to require the arming of Red Sea ships with archers.

Avoiding the central Arabian coast was therefore a priority—stray too close and risk capture or death. The character of the area may be responsible for the strategic choices made by Aelius Gallus, who, in 26/5 B.C.E., attempted to conquer south Arabia. Arriving at Leuke Kome with a fleet of 130 transports and 80 warships, Gallus eschewed both his ships and more southerly ports that would have minimized “the grueling overland”³¹ six-month march down the peninsula (Strabo 16.4.23–4).³² While it was the norm for Roman armies to survive off the resources of the areas they were passing through,³³ perhaps his choice of avoiding a faster sea route was due to the lack of serviceable or friendly harbors, as well as the uncertainties of the availability of supplies along the Arabian coast. Gallus’ attempt was, as is well known, futile—he stopped just a few days short of his goal.³⁴ On the retreat, he and his legions exited Arabia at Egra (Strabo 16.4.24) after a northward 60-day march through a series of inland towns,³⁵ bypassing the inhospitable coast.

Although the central Arabian coast was shunned as environmentally hazardous and as home to pirates and may also have been lacking in resources, the danger posed by the reefs, while real, may not have been as detrimental to seafaring as the ancient authors would have us believe.³⁶ The African side of the sea has been sailed since at least the third millennium B.C.E., when the earliest recorded Egyptian expeditions to Punt took place.³⁷ The occurrence of early seafaring endeavors is particularly important for understanding the con-

ditions of the Arabian side, as the two shores of the Red Sea present similar sailing and geographic conditions. A network of reefs along both the African and Arabian coasts blocks access to the land in many places and prevents watercraft from reaching the shore.³⁸ Harbors occur at breaks in the reef network, particularly at, but perhaps not limited to, wadi mouths and *sharms*.³⁹ Indeed, several harbors occur on both sides of the Red Sea at roughly the same latitude, at least in the northern half of the sea. The previously mentioned Egra lies opposite Myos Hormos, where Gallus landed his troops (Strabo 16.4.24). Likewise, Jeddah is opposite Suakin, and Yanbu lies across from Berenice. In the south, the twinning of the Dahlak Archipelago on the western side with the Farasān island group on the eastern side is readily apparent—they occur at similar latitudes, and each contains one major island and many smaller ones. This accident of twin geography perhaps supported east–west sailing from the earliest times.⁴⁰

While the reef networks along the Red Sea coasts are a hazard, coastal routes existed, as Ibn Majid noted.⁴¹ Obviously, the Arabian pirates mentioned in the *Periplus Maris Erythraei* sailed these waters. They would at least have used the passageways between shore and reef for traveling between local settlements,⁴² perhaps engaging in cabotage, the local commerce that moved many of the goods of the ancient world.⁴³ Inshore sailing differed from open-water travel, as it required little navigational aid beyond landmarks and the knowledge of danger zones.⁴⁴ There is no reason ancient seafarers—pirate or otherwise—could not have sailed the coast and maintained some form of harborage to service craft, crews, and commerce. Determining where they did so is a main focus of this archaeological survey.

THE SURVEY ALONG THE CENTRAL COAST

Kennedy and Bishop’s recent analysis of images on Google Earth reveals a vast number of inland archaeological sites east of Jeddah,⁴⁵ but the coastal

³⁰ Casson 1989, 46.

³¹ Sidebotham 1986, 121–22.

³² Jameson 1968, 76–7; Sidebotham 1986, 120.

³³ Sidebotham 1986, 122, 127.

³⁴ Gallus reached Yemen at Athrula, which an inscription “obliquely confirms” as modern Barakish (Sidebotham 1986, 126).

³⁵ Sidebotham 1986, 120.

³⁶ Villiers (1961, 251–52) sailed up the Arabian coast in a traditional Arabian craft, and while the reefs posed a danger by day and prevented night sailing, the trip was made without incident thanks to the captain and crew who knew the reefs well.

³⁷ Boivin et al. 2010, 261. The evidence of such expeditions is aptly illustrated by the findings at Mersa Gawasis (Ward and Zazzaro 2010; Ward 2012).

³⁸ Ingraham et al. 1981, 63.

³⁹ Murray and Warmington 1967, 25.

⁴⁰ Evidence of early sea crossings between the shores of the southern reaches of the sea is seen in the movement of obsidian from Africa to Arabia in the third millennium B.C.E. (Fat-tovich 2012, 39).

⁴¹ Tibbetts 1961, 325.

⁴² Villiers (1961, 251) notes watercraft called *sambuks* sailing the coastal channel between reefs and mainland, including “two from Massawah one morning, in the inside passage off Midi: they were beating down to Aden and came the inside way for its flat sea. They know the reefs.”

⁴³ Hohlfelder and Vann 2000, 126.

⁴⁴ Tibbetts 1961, 63.

⁴⁵ Kennedy and Bishop 2011.

area has received little attention. In comparison with the northwest coast, the Jeddah region is surprisingly free of known ancient harbors. This is not to say that the region is unsuitable geographically for ships and shipping. The Rabigh *sharm* and the Khor al-Kharrar lagoon just to the north make fine anchorages, as does Sharm Abhur and the bay at Jeddah itself.

The inland waterway around Jeddah, located between the mainland and outlying Eliza Shoals and extending north to Rabigh and south to al-Shoaiba, creates a conduit for local sea traffic. Additionally, the southern end of Eliza Shoals is directly west of Jeddah's Sharm Abhur, providing opportunity for open-water ships to skirt the shoals on the seaward side and access the shore at Sharm Abhur or Jeddah—the first major access points south of Rabigh. As such, Jeddah and its vicinity represent a juncture of the differing sailing routes, with implications for harbors, both formal and informal, and for shipwrecks of archaeological importance. The absence of archaeological maritime data for the area, therefore, may be due to the scant archaeological research in the region.

Rabigh/Khor Al-Kharrar

The area of Rabigh contains a *sharm*, now a major industrial sector, and the lagoon Khor al-Kharrar, which stretches approximately 20 km along the coast.⁴⁶ Between *sharm* and lagoon, the beachfront is typical of the Arabian coast, lined with fossil coral shelves of ancient shorelines. On the seafront near the southern area of the lagoon, the fossil coral gives way to a shanty-lined sandy beach that is used by fishermen as an informal harbor, despite that it has little natural protection from the elements. It is a strand where boats can be drawn onto the sand in inclement weather, and the shanties are inhabited only when fishing occurs. Perhaps drawing boats onto the strand is an ancient practice as well as a modern one. If this is the case, then there may be few expectations of finding any permanent harbor structures. Nevertheless, preliminary exploration along the southern edge of the lagoon resulted in the discovery of a jetty constructed of rough coral pieces (fig. 2).

The jetty is approximately 24 m long x 2 m wide and has a low profile. It is elevated approximately 30 cm above the surrounding sand. The outer end of the jetty lies in the damp sand of the tidal flats that characterize the area.⁴⁷ The flats stretch toward the water for perhaps another 20 m beyond the jetty's end. The area is extremely shallow, although depths within the



FIG. 2. Two views of the jetty at Khor al-Kharrar: *top*, the jetty, looking north into the lagoon, from the high ground near the middens and fireplaces (R. Pedersen); *bottom*, the jetty from the edge of the lagoon (the rise in the background on the right is the high ground where the middens and fireplaces are located) (G. Knepel).

lagoon can reach 8 m.⁴⁸ The true interface between land and water is difficult to discern, as its location is variable based on wind and water conditions. The jetty is nevertheless now unserviceable, as it cannot be reached by boat, nor can the structure be used for fishing. Thus, the jetty must have been constructed in a period of deeper water conditions along the southern edge of the lagoon. Sediment studies show that deposits in the southern sections of the lagoon are finer than those in the north and are due to flash flooding in the rainy season, but the rate of deposition is not known.⁴⁹ There were no artifacts associated with the jetty, which would have aided in the dating of the

⁴⁶ Al-Washmi 1999, 71.

⁴⁷ Al-Washmi 1999, 71. Sediment deposits in the southern reaches of the lagoon are predominately due to flash flooding

(Al-Washmi 1999, 85).

⁴⁸ Abu-Shanab et al. 1999.

⁴⁹ Al-Washmi 1999, 76, 85.

structure. As the team was conducting a preliminary walking survey of the area, no digging was done. The digging of a sondage adjacent to the jetty may reveal artifacts, such as pottery discards from boats and general activity, as well as the depth of the construction. This remains for future investigation.

At the landward end of the jetty is a small rise of about 3 m. On top of this are a few mollusk-shell middens. All the middens are small, approximately 1 m across, and none protrudes above the surrounding sand. A small arc of coral pieces was arranged around the western edge of the midden closest to the jetty. The other two middens display no such arrangement. Two fireplaces were also found on the rise (fig. 3). These consisted of oval, flat black stones approximately 10 cm across. Informants within our Saudi contingent stated that people used to heat such rocks in fires and then cook meat, fish, or shellfish on the hot stones. As with the jetty, there were no artifacts associated with either the middens or the fireplaces, and therefore the dates of these features could not be determined.

Clearly, the jetty was built to allow access from the land to deeper water for the receiving of boats, most likely local fishing craft, as perhaps indicated by the shell middens. The middens are apparently related to the jetty, as none was found elsewhere in the general area. Whether the jetty, middens, and fireplaces predate modern activities is a question that can be answered only by more extensive investigation.

Al-Shoaiba, Ancient Port of Mecca

Al-Shoaiba was the harbor for Mecca in pre-Islamic and Early Islamic times until Jeddah rose to prominence.⁵⁰ Although it appears to have had no formal development, al-Shoaiba “accommodated some kind of ship-berthing and loading/off-loading activity . . . [as] one of the very few places along the western Arabian coast which could have accommodated such activity.”⁵¹ It served to bring foreign goods to Mecca, which was only 85 km away, and to send Mecca-area products, such as leather and horn-based goods, into the maritime network linking Mecca to the southern Red Sea cultures, such as the Aksumite kingdom.⁵² Indeed, al-Shoaiba was the place from which the early Muslims fleeing persecution sailed for refuge in the



FIG. 3. A midden of mollusk shells on the rise behind the jetty at Khor al-Kharrar, with a low semicircle of coral pieces on its western edge (J. Wangen).

Aksumite lands, and even later a force was launched from there to repel hostile ships.⁵³

Al-Shoaiba is a shallow lagoonal complex consisting of Khawr ash Shaibah al Masdudah in the north and Khawr ash Shaibah al Maftuhah in the south.⁵⁴ The complex, which reaches more than 13 km north–south and a maximum of 2.5 km wide, is prone to siltation by aeolian deposits and waterborne sediments carried through two channels linking the lagoons to the sea.⁵⁵ Mangrove trees, now endangered,⁵⁶ stand along its shores in places. The groves may have contributed to the shallowness of the lagoon via the deposition of decaying matter.⁵⁷ The eastern shores of the lagoons are shallow and indistinct, as at Khor al-Kharrar, with tidal flats extending to the east. Deeper areas occur near the inlets.

Work at al-Shoaiba concentrated on a brief walking survey along the two inlets. How easily the area could be accessed—that is, whether ships were able to sail into the lagoon—was an important question. Both inlets are deep (the southern one can reach a depth of 6 m)⁵⁸ and wide enough to permit the transit of watercraft, but the shallowness of the lagoons would have prevented larger boats from penetrating far into them. Perhaps ancient ships either simply moored alongside the inlets, as do the modern fishing craft, or were drawn onto the beach (fig. 4). The walking

⁵⁰Jandora 1995, 334. It is unknown when Jeddah was founded and al-Shoaiba abandoned. One late story attributes the events to ‘Uthmān ibn ‘Affān in 647 C.E. (Hawting 1984, 321).

⁵¹Jandora 1995, 334. The Arabic term used in conjunction with harbors such as al-Shoaiba is *sāhil*, which has been translated as either “port” or the more vague “coastal entrepôt for inland commerce” (Wansbrough 1970, 92).

⁵²Jandora 1995, 335, 341, 343.

⁵³Hawting 1984, 319.

⁵⁴Rasul et al. 2013. “Khawr” is an alternate spelling for “Khor” as in “Khor al-Kharrar.”

⁵⁵Al-Washmi 2003, 9.

⁵⁶Awari and Mullah 2010.

⁵⁷Biagi and Nisbet 2006, 222.

⁵⁸Al-Washmi 2003, 7.



FIG. 4. The modern harbor at al-Shoaiba, southern inlet (W. Held).

survey along each inlet at al-Shoaiba revealed no ancient detritus, such as the broken pottery expected in a harbor site, or signs of ancient use. However, the southern sides of each inlet were not examined, as they were inaccessible. The mangrove stands within the lagoon and their exploitation for wood were likely determining factors in the selection of places such as al-Shoaiba.⁵⁹ Thus, if watercraft accessed the lagoon, they would likely have stayed in the vicinity of the inlets and accessed the mangrove wood via small boats.⁶⁰

Given al-Shoaiba's maritime role, it is not surprising that some accounts relate the loss of a Byzantine or Aksumite ship there in the late sixth or early seventh century. The timbers from the ship were subsequently used to rebuild the Ka'ba.⁶¹ This wreck has not been found, although two other shipwrecks at al-Shoaiba are known to exist. One of these is said by unnamed local sources to contain large "jars" of unknown type,

several of which are said to have been removed by divers for household and garden decoration. The other is the so-called Silver Coin Wreck. This site has long been the target of sport divers, and in the 1990s several thousand 13th-century coins were removed from the wreck and brought to Key West, Florida. The coins were subsequently advertised on the Internet, which brought them to the attention of Saudi and international authorities. After a series of negotiations, the coins were returned to Saudi Arabia in 2006,⁶² and in 2011–2012 they were on display in the National Museum of Saudi Arabia in Riyadh. The location of the wreck is presently unknown.

Eliza Shoals

The Eliza Shoals lie northwest of Jeddah. This is a vast, shallow area of reefs and coral heads interspersed with lagoons, which are in places less than 0.5 m deep.

⁵⁹ Biagi and Nisbet 2006, 221.

⁶⁰ There is some question whether the lagoonal location is actually ancient al-Shoaiba, as the current identification seems to have entered western scholarship only in the mid 19th century. In his study of ancient Arabian geography, Sprenger (1875, 39–40) identified al-Shoaiba as Ptolemy's Kentos Kome (κέντος κόμη) and placed it at the lagoon only after viewing British Admiralty charts, which did not contain the name "al-Shoaiba" or any variant for the area (Hawting 1984, 325). Additionally, Muslim scholars of the Early Islamic

period apparently "had no real knowledge" of al-Shoaiba beyond "meager details" contained in stories (Hawting 1984, 325). See Hawting (1984) for a fuller discourse on the identification question.

⁶¹ Hawting 1984, 318; Peters 1994, 48; Glassé and Smith 2003, 245. Some versions of the story place the wrecking at Jeddah, but the location of al-Shoaiba is better attested in Hawting 1984, 320.

⁶² According to information at the exhibition in the National Museum of Saudi Arabia, Riyadh, March 2012.

No islands occur, as the reef and coral heads barely break the surface. Between the shoals and the mainland is a deep trench. According to British Admiralty charts, a short coral shelf adjacent to the land quickly plunges to depths of more than 700 m, forming a channel between the mainland and the shoals. A short shelf surrounds the shoals on the channel side as well as on their seaward edge. This seaward shelf forms at the bases of the reefs, about 10 m beneath the surface, and generally descends to depths of 30 m or more before dropping into the abyss of the Red Sea.

It is possible for modern small boats and yachts to navigate in between the reefs in calm weather, but this would be hazardous without the aid of engines. Given the vagaries of winds, only a foolhardy sailor would take anything larger than a small fishing vessel over the shoals. Thus, ancient sea traffic would have been confined to the intercoastal channel and to skirting the seaward side of the reef. Long-distance vessels would have approached the area rarely, keeping to the middle of the sea for safety from the reefs and from raiders. It was thus expected that shipwrecks in the area would represent local coastal craft, seagoing ships heading to the Jeddah area for trade or replenishment of water or victuals, the occasional ship running before a storm for the safety of a harbor, or a ship blown inward toward the shoals. With these geographic and maritime parameters in mind, the survey began an underwater search at selected areas of the shoals—that is, in those areas believed more likely to pose a hazard to ancient ships. Our effort was rewarded on the second day with the discovery of a shipwreck.

The team first found the top of an amphora lying along the base of a reef. It then discovered several encrusted rectangular blocks of undetermined stone type, a large amphora sherd concreted into the reef, and another amphora, of a different type than the first, cemented into the seafloor matrix of sand and dead coral. This assemblage, while small, led the team to the hypothesis that this was a shipwreck site. The area stretching out from the reef is a level expanse of dead coral and sand that runs along the base of the reef until dropping off into deeper water, a typical seascape of the area.

The amphora top was raised for diagnostic purposes. It consisted of the mouth, the neck, a handle, and part of the shoulder of a large amphora (fig. 5). The mouth was funnel-shaped, and the remaining handle arched out high on the shoulder and apparently joined the neck below the funnel mouth, as best as could be seen through the overlying encrustation.

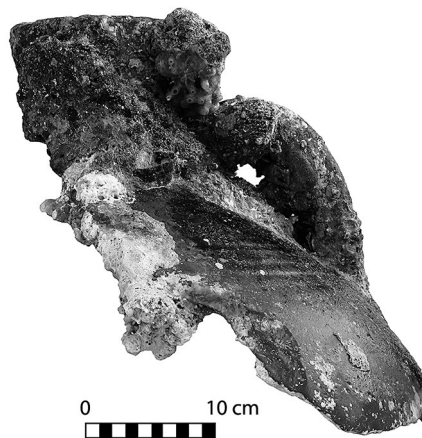


FIG. 5. The top of a large amphora believed to be of the Dressel 24 Similis D type. The piece was sent to the National Museum of Saudi Arabia in Riyadh for cleaning and conservation (R. Brandmeier).

There were nine or 10 bands of rilling on the shoulder, although the exact number was difficult to discern because of the vessel's uncleaned state. The fabric was red brown when wet. There was no covering slip, and no stamps or graffiti were visible. The interior surface exhibited wheel marks, and no coating was seen. It is likely the Dressel 24 Similis D type, a precursor to the Late Roman 2 amphora. Dating to the late third or the fourth century, it is noted for its funnel mouth, arching handles, and shoulder bands.⁶³ Dressel 24 Similis D and other Similis types have been identified as Greek-made containers for olive oil based on some examples in Dacia and Rome that are marked with the *dipinto* "oleum."⁶⁴

A body sherd of a vessel was found nearby concreted into the reef. As this sherd had the same fabric thickness and type as the amphora top, it is possible that it belonged to the same vessel. No other fragments of this container were found, but given the coral growth and the coral death that leaves an abundance of rubble on the seafloor, it is likely that additional fragments have been covered by or incorporated into the reef. A few meters away from the amphora top, another amphora was found buried in the seabed. Enough overburden was cleared away to reveal the remains of the neck and a section of the body. The foot could not be exposed. The overburden's upper section consisted of loose sand and dead coral, while deeper down, perhaps at 10 cm, the coral matrix became hard and compact, making further manual clearing impossible.

⁶³Kaan Senol, pers. comm. 2012; Opait 2007, 632–33.

⁶⁴Opait 2007, 633.

Nevertheless, some information about the vessel could be gleaned. Its undecorated fabric was dark brown when wet. The neck was broken and reduced to remnants around the body join. A stub of a handle sat high on the shoulder, and the stub of the upper join sits at the base of the neck or just below it. Perhaps the most important feature of the amphora was a hole, approximately 1 cm in diameter, low in the neck (fig. 6). Amphoras could be reused and even modified through the punching or drilling of holes, although creating such holes through fired ceramics typically damages the surrounding fabric, chipping off pieces and even forming a “crater” around the hole.⁶⁵ These holes could be abraded with rasps and files to smooth them.⁶⁶ Close examination of the amphora on the wreck site, however, revealed that the external surface of the hole was smooth and regular, and the surrounding surface and edges showed none of the damage that postfiring modification would produce. Therefore the hole may have been produced before firing and is probably a secondary fermentation lock. Examples of fermentation locks are found in amphora necks or stoppers at several Egyptian sites, such as Tutankhamun’s tomb, the Monastery of Epiphanius at Thebes, and Medum.⁶⁷ The locks provided an escape for gases produced by the wine-fermentation process either when it was not completed in larger vats before transference to smaller storage vessels or when environmental conditions, such as movement or temperature, created renewed fermentation. Lucas and Harris explain:⁶⁸

The closing of the jars as soon as possible was essential, since if the wine had been left exposed to the air, another kind of fermentation (the acetous fermentation) caused by a minute organism (*Mycoderma aceti*), always present in the air, would have taken place, which would have converted the alcohol into acetic acid and the wine would have become vinegar. The jars, however, were not all sealed hermetically at this stage, since in some instances slow fermentation was still going on, in which case a small hole was drilled in the neck of the jar, or made in the stopper . . . to provide a way of escape for the carbon dioxide being given off in small amount, and, when the fermentation was finished, this hole was sometimes “stopped with a wisp of straw” and sometimes closed with clay and sealed.

⁶⁵ A good example of drilling or puncture damage around a hole is seen in the neck of a Type AE7/LR7 Egyptian amphora (inv. no. P3012) in the Alexandria Graeco-Roman Museum. See the entry for Type AE7 in the Alexandrian Centre for Amphora Studies database (www.amphoralex.org/amphores/AE/AmphoresAE7.php).

⁶⁶ Peña 2007, 122–23.

⁶⁷ Winlock and Crum 1926, 79; Carter 1934, 148–49; Lucas



FIG. 6. The hole in the neck of an amphora found in a shipwreck in the Eliza Shoals.

While Butcher and Opait note that in general wine amphoras were often designed with a long neck to accommodate the expanding gases produced by continuing fermentation,⁶⁹ many of those in Egypt from various periods have a small hole in the neck.⁷⁰ The practice is illustrated in a mural of the wine-making process in the 18th Dynasty tomb of Khaemweset.⁷¹ James sees evidence even earlier in Old Kingdom wine making:⁷²

[As] there is good evidence to suggest that when a jar was sealed a vent was left open for the escape of final fermentation gases, it should follow that it was common practice to pour wine into storage jars in the expectation that fermentation would be completed in the jar, or at least some allowance should be made for the possibility of secondary fermentation.

These holes could often be sealed with clay.⁷³

Such a lock or vent was particularly needed when young wine was to be shipped, as the continuing fermentation process and the gassing off of carbonic anhydride⁷⁴ accelerated as a result of the movement incurred in transport as well as the heat. Indeed, fanning

and Harris 1962, 19.

⁶⁸ Lucas and Harris 1962, 19.

⁶⁹ Butcher 2003, 173; Opait 2010, 154.

⁷⁰ Opait 2010, 154.

⁷¹ Estreicher 2006, 20.

⁷² James 1996, 207.

⁷³ McGovern 2003, 129; Estreicher 2006, 20.

⁷⁴ Guasch Jané 2008, 21.

wine-filled amphoras to reduce their temperature seems to have been an Egyptian practice.⁷⁵ Thus, precautions were taken to allow amphoras to breathe, whether on the relatively calm Nile or on the rougher sea.⁷⁶ As there is little evidence of locks in amphora necks from the northern shores of the Mediterranean—although the phenomenon of continued fermentation and its associated problems was known to the Romans⁷⁷—it appears that the feature may be a southern Mediterranean, specifically Egyptian, one. Locks may have been included in some amphoras with relatively short necks because of factors in wine production and transport in hotter climates.⁷⁸

CONCLUSIONS

The preliminary survey revealed a former harbor for local craft in Khor al-Kharrar and located what is likely a shipwreck. The finding of the wreck site raises important questions about the maritime activities along the central Red Sea coast of Saudi Arabia. Was the ship a stray, lost and running before a storm, only to be wrecked near an inhospitable coast? Or was it a ship intending to make landfall in Sharm Abhur or in the bay now home to Jeddah? The latter scenario suggests the existence of a settlement in the vicinity in the period—yet none is known for certain from either literature or archaeology.

Only the most basic inferences can be made about the nature of the site. We cannot yet say definitely whether the amphoras were carrying wine or olive oil, as it is possible that the amphoras were being reused. Amphoras were of course frequently reused or recycled at their terminal consumption point.⁷⁹ They could also be reused for transport of goods on ships.⁸⁰ As there is as yet no additional evidence for such wine transport at the site, we can only tentatively suggest that the evidence of the amphora points to the transport of wine in the late third or the fourth century. If wine, particularly young wine, was indeed one of the cargoes on the wreck, then an origin for the commodity

should be expected to be close to the Red Sea region. An Egyptian source is a probability; along with the Nile Delta, the area of Egypt near the Red Sea was a wine-production center.⁸¹ The inclusion of the secondary fermentation lock supports the hypothesis of a Romano-Egyptian origin. Likewise, it is cautiously suggested that the Dressel 24 Similis D amphora is evidence for the shipping of olive oil down the Red Sea coast of the Arabian Peninsula.

Locating the main body of the shipwreck will be a priority for future surveys; at present, it is not known where the bulk of the ship rests. The ship may have struck the reef and drifted along its face, spilling cargo as it sank and ultimately settling far from the reef. It is also possible that it lies underneath the field of dead coral. Indeed, two of the three excavated shipwrecks in the Red Sea exhibit this type of site formation, in which only a portion of the artifacts are in the surface matrix and the bulk of the site is buried under coral. Raban describes the Ottoman-period shipwreck at Sharm el-Sheikh excavated in the 1960s:⁸²

A curious feature of the situation was a thin layer of sand at the bottom of the sea and just underneath it, a hard, rocky crust about 20 to 30 centimeters thick. . . . This crust served as a layer insulating the remains of the ship. On top of the crust only some decayed beams of the ship remained . . . and quite a number of pottery vessels.

A similar situation was found on the wreck at Black Assarca Island, where a layer of sand and sherds covered a stratum of coral, under which were amphoras.⁸³

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⁷⁵ Murray 2000, 590.

⁷⁶ McGovern 2003, 129.

⁷⁷ Varro, *Rust.* 1.13.6: “Illic laudabatur villa, si habebat culinam rusticam bonam, praesepis laxas, cellam vinariam et oleariam ad modum agri aptam et pavimento proclivi in lacum, quod saepe, ubi conditum novum vinum, orcae in Hispania fervore musti ruptae neque non dolea in Italia.” Heslin (2011) states that wine transported on dolia-bearing ships was expected to finish fermentation en route to market and that the failure of dolia under pressure from fermentation was a hazard and even contributed to the loss of one ship.

⁷⁸ Not all wine amphoras from southern climes contained a lock. Only about half of those from the Monastery of Epiphanius had locks, and only some wine amphoras found in the Monastery of Baramus in the Wadi Natrun contained the fea-

ture. In juxtaposition, none of the Byzantine-period Aqaba amphoras shipped to Aksum, Yemen, and beyond is known to contain a lock, either in the neck or in the stopper (Lucas and Harris 1962, 19; Konstantinidou 2010, 952). For various examples of Aqaba amphoras (also known as Ayla-Axum amphoras), see Sidebotham et al. 1989, fig. 17, no. 4; Sedov 1992, 113; 2006, 87, 95–6; Pedersen 2000, 5, fig. 3; 2008, 83, fig. 5; Raith et al. 2013.

⁷⁹ Konstantinidou 2010, 952.

⁸⁰ See, e.g., Van Doorninck 1989.

⁸¹ Estreicher 2006, 18.

⁸² Raban 1971, 147.

⁸³ Pedersen 2008, 82. Additionally, it should be noted that no such coral layer was reported for recently examined Roman wreck sites in Egyptian waters (Blue et al. 2012).

Works Cited

- Abu-Shanab, M.A., A.S. Mandura, and A.S. Basaham. 1999. "Mangrove Vegetation of Khor Al-Kharrar, Red Sea." Abstract. *Second Symposium on the Red Sea Marine Environment*. www.kau.edu.sa/Files/320/Researches/34658_Pages%20from%206-10.pdf.
- Al-Mughannam, A., S. Al-Helwa, and J. Mursi. 1983. "Catalogue of Stations on the Egyptian (Coastal) and Syrian (Inland) Pilgrim Routes." *Atlat* 7:42–9.
- Al-Washmi, H.A. 1999. "Sedimentological Aspects and Environmental Conditions Recognized from the Bottom Sediments of Al-Kharrar Lagoon, Eastern Red Sea Coastal Plain, Saudi Arabia." *Journal of King Abdulaziz University, Marine Sciences* 10:71–87.
- . 2003. "Sediment Distribution Pattern in the Al-Shoaiba Lagoon, Red Sea Coast of Saudi Arabia." *Qatar University Science Journal* 23:5–22.
- Awari, E.H., and A.M. Mullah. 2010. "Analysis of Spatial Changes of Coastal Environments for the Shuaiba in the Western Region of Kingdom of Saudi Arabia Using Remote Sensing Technique." *Meteorology, Environment and Arid Land Agriculture Sciences Journal* 21(2):171–95.
- Bailey, G.N., N.C. Flemming, G.C.P. King, K. Lambeck, G. Momber, L.J. Moran, A. Al-Sharekh, and C. Vita-Finza. 2007. "Coastlines, Submerged Landscapes, and Human Evolution: The Red Sea Basin and the Farasan Islands." *The Journal of Island and Coastal Archaeology* 2(2):127–60.
- Biagi, P., and R. Nisbet. 2006. "The Prehistoric Fisher-Gatherers of the Western Coast of the Arabian Sea: A Case of Seasonal Sedentarization?" *WorldArch* 38(2):220–38.
- Blue, L., J.D. Hill, and R.I. Thomas. 2012. "New Light on the Nature of Indo-Roman Trade: Roman Period Shipwrecks in the Northern Red Sea." In *Navigated Spaces, Connected Places: Proceedings of the Red Sea Project V, Held at the University of Exeter, 16–19 September 2010*, edited by D.A. Agius, J.P. Cooper, A. Trakadas, and C. Zazzaro, 91–100. BAR-IS 2346. Oxford: Archaeopress.
- Boivin, N., R. Blench, and D.Q. Fuller. 2010. "The Evolution of Human Populations in Arabia." In *The Evolution of Human Populations in Arabia: Paleoenvironments, Prehistory, and Genetics*, edited by M.D. Petraglia and J.I. Rose, 251–78. Dordrecht and New York: Springer.
- Burton, R. 1879. *The Land of Midian (Revisited)*. Vol. 2. London: Kegan Paul.
- Butcher, K. 2003. *Roman Syria and the Near East*. Los Angeles: Getty Publications.
- Carter, H. 1934. *Tut-en-ch-Amun: Ein ägyptisches Königsgrab. Entdeckt von Earl of Carnarvon und Howard Carter*. Leipzig: Brockhaus.
- Casson, L. 1989. *The Periplus Maris Erythraei: Text with Introduction, Translation, and Commentary*. Princeton: Princeton University Press.
- Cooper, J.P., and C. Zazzaro. 2012. "A Stone Anchor from the Farasan Islands, Saudi Arabia." *IJNA* 41(2):407–11.
- Damgaard, K. 2011. "Modelling Mercantilism: An Archaeological Analysis of Red Sea Trade in the Early Islamic Period (650–1100 CE)." Ph.D. diss., University of Copenhagen.
- De Procé, S.M., and C. Phillips. 2010. "South Arabian Inscriptions from the Farasān Islands (Saudi Arabia)." Poster. In *Proceedings of the Seminar for Arabian Studies*. Vol. 40, edited by J. Starkey, 277–82. Oxford: Archaeopress.
- Dietrich, A. 1965. *Ad-Djar: The Encyclopedia of Islam*. Vol. 2. Leiden: Brill.
- Durand, C. 2012. "Crossing the Red Sea: The Nabataeans in the Egyptian Eastern Desert." In *Navigated Spaces, Connected Places: Proceedings of the Red Sea Project V, Held at the University of Exeter, 16–19 September 2010*, edited by D.A. Agius, J.P. Cooper, A. Trakadas, and C. Zazzaro, 85–90. BAR-IS 2346. Oxford: Archaeopress.
- Estreicher, S. 2006. *Wine: From Neolithic Times to the 21st Century*. New York: Algora Publishing.
- Fattovich, R. 2012. "The Southern Red Sea in the 3rd and 2nd Millennia BC: An Archaeological Overview." In *Navigated Spaces, Connected Places: Proceedings of the Red Sea Project V, Held at the University of Exeter, 16–19 September 2010*, edited by D.A. Agius, J.P. Cooper, A. Trakadas, and C. Zazzaro, 39–46. BAR-IS 2346. Oxford: Archaeopress.
- Glassé, C., and H. Smith. 2003. *The New Encyclopedia of Islam*. Walnut Creek, Calif.: AltaMira Press.
- Guasch Jané, M.R. 2008. *Wine in Ancient Egypt: A Cultural and Analytical Study*. BAR-IS 1851. Oxford: Archaeopress.
- Hawting, G.R. 1984. "The Origin of Jedda and the Problem of Al-Shu'ayba." *Arabica* 31(3):318–26.
- Heslin, K. 2011. "Dolia Shipwrecks and the Wine Trade in the Roman Mediterranean." In *Maritime Archaeology and Ancient Trade in the Mediterranean*, edited by D. Robinson and A. Wilson, 157–68. Oxford Centre for Maritime Archaeology Monograph 6. Oxford: Oxford Centre for Maritime Archaeology.
- Hitti, P. 1916. *The Origins of the Islamic State: Being a Translation from the Arabic, Accompanied with Annotations, Geographic and Historic Notes of the Kitāb fitūh al-buldān of al-Imām abu-l Abbās Ahmad ibn-Jābir al-Balādhuri*. New York: Columbia University Press.
- Hohlfelder, R.L., and R.L. Vann. 2000. "Cabotage at Aperlae in Ancient Lycia." *IJNA* 29(1):126–35.
- Ingraham, M.L., T.D. Johnson, B. Rihani, and I. Shatla. 1981. "Saudi Arabian Comprehensive Survey Program: C. Preliminary Report on a Reconnaissance Survey of the Northwestern Province (with a Note on a Brief Survey of the Northern Province)." *Atlat* 5:59–84.
- James, T.G.H. 1996. "The Earliest History of Wine and Its Importance in Ancient Egypt." In *The Origins and Ancient History of Wine*, edited by P.E. McGovern, S.J. Fleming, and S.H. Katz, 197–213. Food and Nutrition in History and Anthropology 11. Amsterdam: Gordon and Breach.
- Jameson, S. 1968. "Chronology of the Campaigns of Aelius Gallus and C. Petronius." *JRS* 58:71–84.
- Jandora, J.W. 1995. "The Rise of Mecca: Geopolitical Factors." *The Muslim World* 85(3–4):333–44.
- Kennedy, D., and M.C. Bishop. 2011. "Google Earth and the Archaeology of Saudi Arabia: A Case Study from the Jeddah Area." *JAS* 38(6):1284–93.
- Konstantinidou, A. 2010. "Aspects of Everyday Life in a Monastic Settlement: Amphorae and Cooking Ware (4th–7th c.) from the Old Monastery of Baramus in the Wadi Natrun (Egypt). A First Glance." In *LRCW3: Late Roman Coarse Wares, Cooking Wares and Amphorae in the Mediterranean. Archaeology and Archaeometry. Comparison Between Western and Eastern Mediterranean*. Vol. 2, edited by S. Menchelli, S. Santoro, M. Pasquinucci, and G. Guiducci, 951–61. BAR-IS 2185. Oxford: Archaeopress.
- Lucas, A., and J.R. Harris. 1962. *Ancient Egyptian Materials and Industries*. 4th ed. London: Edward Arnold.
- Mayerson, P. 1992. "The Island of Iotabê in the Byzantine Sources: A Reprise." *BASOR* 287:1–4.
- . 1995. "A Note on Iotabê and Several Other Islands in the Red Sea." *BASOR* 298:33–5.

- McGovern, P.E. 2003. *Ancient Wine: The Search for the Origins of Viticulture*. Princeton: Princeton University Press.
- Murray, G.W., and E.H. Warmington. 1967. "Trogodytica: The Red Sea Littoral in Ptolemaic Times." *The Geographical Journal* 133 (1):24–33.
- Murray, M.A. 2000. "Viticulture and Wine Production." In *Ancient Egyptian Materials and Technology*, edited by P. Nicholson and I. Shaw, 577–608. Cambridge: Cambridge University Press.
- Musil, A. 1926. *The Northern Heġāz: A Topographical Itinerary*. Oriental Explorations and Studies 1. New York: American Geographical Society of New York & Czech Academy of Sciences and Art.
- Nalesini, O. 2012. "Sacred Places and Beings of the Red Sea Littoral Societies." In *Navigated Spaces, Connected Places: Proceedings of the Red Sea Project V, Held at the University of Exeter, 16–19 September 2010*, edited by D.A. Agius, J.P. Cooper, A. Trakadas, and C. Zazzaro, 77–84. BAR-IS 2346. Oxford: Archaeopress.
- Nappo, D. 2010. "On the Location of Leuke Kome." *JRA* 23:334–48.
- Opait, A. 2007. "From DR 24 to LR 2?" In *LRCW2: Late Roman Coarse Wares, Cooking Wares and Amphorae in the Mediterranean. Archaeology and Archaeometry*. Vol. 2, edited by M. Bonifay and J. Treglia, 627–43. BAR-IS 1662. Oxford: Archaeopress.
- . 2010. "Aspects of the Provisioning of the Pontic Settlements with Olive Oil in the Hellenistic and Early Roman Periods." In *Patabs I: Production and Trade of Amphorae in the Black Sea. Actes de la Table ronde internationale de Batoumi et Trabzon, 27–29 avril 2006*, edited by D.K. Tezgor and N. Inaishvili, 153–58. Varia Anatolica 21. Istanbul: Institut Français d'Études Anatoliennes.
- Pedersen, R.K. 2000. "Under the Erythraean Sea: An Ancient Shipwreck in Eritrea." *The INA Quarterly* 27 (2–3): 3–12.
- . 2008. "The Byzantine-Aksumite Period Shipwreck at Black Assarca Island, Eritrea." *Azania* 43:77–94.
- Peña, J.T. 2007. *Roman Pottery in the Archaeological Record*. Cambridge: Cambridge University Press.
- Peters, F.E. 1994. *Mecca: A Literary History of the Muslim Holy Land*. Princeton: Princeton University Press.
- Power, T. 2012. "Trade Cycles and Settlement Patterns in the Red Sea Region (ca. 1050–1250)." In *Navigated Spaces, Connected Places: Proceedings of the Red Sea Project V, Held at the University of Exeter, 16–19 September 2010*, edited by D.A. Agius, J.P. Cooper, A. Trakadas, and C. Zazzaro, 137–45. BAR-IS 2346. Oxford: Archaeopress.
- Raban, A. 1971. "The Shipwreck at Sharm el Sheikh." *Archaeology* 24:146–55.
- Raith, M.M., R. Hoffbauer, H. Euler, P.A. Yule, and K. Damgaard. 2013. "The View from Zafar: An Archaeometric Study of the Aqaba Pottery Complex and Its Distribution in the 1st Millennium CE." *Zeitschrift für Orient-Archäologie* 6:318–48.
- Rasul, N., R. Al-Farawati, O. Al-Harbi, and A.N. Qutub. 2013. "Sediment Characteristics and Water Quality in the Two Hyper-Saline Lagoons Along the Red Sea Coast of Saudi Arabia." Abstract. *Geophysical Research Abstracts* 15:2424. <http://meetingorganizer.copernicus.org/EGU2013/EGU2013-2424-1.pdf>.
- Sedov, A.V. 1992. "New Archaeological and Epigraphical Material from Qana (South Arabia)." *Arabian Archaeology and Epigraphy* 3 (2):110–37.
- . 2006. "The Port of Qana' and the Incense Trade." In *Food for the Gods: New Light on the Ancient Incense Trade*, edited by D. Peacock and D. Williams, 71–111. Oxford: Oxbow.
- Sidebotham, S.E. 1986. *Roman Economic Policy in the Erythra Thalassa: 30 BC–AD 217*. *Mnemosyne* Suppl. 91. Leiden: Brill.
- Sidebotham, S.E., J.A. Riley, H.A. Hamrrouch, and H. Barakat. 1989. "Fieldwork on the Red Sea Coast: The 1987 Season." *JARCE* 26:127–66.
- Sprenger, A. 1875. *Die Alte Geographie Arabiens als Grundlage der Entwicklungsgeschichte des Semitismus*. Bern: Commissionsverlag von Huber und Co.
- Tibbetts, G.R. 1961. "Arab Navigation in the Red Sea." *The Geographical Journal* 127 (3):322–34.
- Tolmacheva, M. 1980. "On the Arab System of Nautical Orientation." *Arabica* 27 (2):180–92.
- Tomber, R. 2004. "Amphorae from the Red Sea and Their Contribution to the Interpretation of Late Roman Trade Beyond the Empire." In *Transport Amphorae and Trade in the Eastern Mediterranean: Acts of the International Colloquium at the Danish Institute at Athens, September 26–29, 2002*, edited by J. Eiring and J. Lund, 393–402. Monographs of the Danish Institute at Athens 5. Athens: Danish Institute at Athens.
- Van Doorninck, F.H., Jr. 1989. "The Cargo Amphorae on the 7th Century Yassi Ada and 11th Century Serçe Limani Shipwrecks: Two Examples of a Reuse of Byzantine Amphorae as Transport Jars." In *Recherches sur la céramique byzantine*, edited by V. Deroche and J.-M. Spieser, 247–57. BCH Suppl. 18. Paris: De Boccard.
- Villiers, A. 1961. "Sailing with the Arabs." *The Mariners Mirror* 47 (4):242–55.
- Wansbrough, J. 1970. "Africa and the Arab Geographers." In *Language and History of Africa: A Volume of Collected Papers Presented to the London Seminar on Language and History in Africa (Held at the School of Oriental and African Studies, 1967–1969)*, edited by D. Dalby, 89–101. London: Cass.
- Ward, C. 2012. "Sailing the Red Sea: Pharaonic Voyages to Punt and Min of the Desert." In *Navigated Spaces, Connected Places: Proceedings of the Red Sea Project V, Held at the University of Exeter, 16–19 September 2010*, edited by D.A. Agius, J.P. Cooper, A. Trakadas, and C. Zazzaro, 25–32. BAR-IS 2346. Oxford: Archaeopress.
- Ward, C., and C. Zazzaro. 2010. "Evidence for Pharaonic Seagoing Ships at Mersa/Wadi Gawasis, Egypt." *IJNA* 39 (1):27–43.
- Winlock, H.E., and W.E. Crum. 1926. *Monastery of Epiphanius at Thebes*. 2 vols. Publications of the Metropolitan Museum of Art Egyptian Expedition 3–4. New York: Metropolitan Museum of Art.
- Zarins, J.N., A. Rahbini, and M. Kamal. 1982. "Preliminary Report on the Archaeological Survey of the Riyadh Area." *Atlat* 6:25–38.