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Rock Art: A Potential Source of Information about Past Maritime Technology in the South-East Asia-Pacific Region

Peter V. Lape

Department of Anthropology, University of Washington, Seattle, USA

Sue O'Connor

Department of Archaeology and Natural History, Research School of Pacific and Asian Studies, Australian National University, Australia

Nick Burningham

P.O. Box 260, Fremantle, Australia

It is possible that most or all boats and rig-types used in prehistoric times in the South-East Asia-Pacific region have completely disappeared from the record, and that those recorded by Europeans in the 17th century may have been relatively recent innovations. The purpose of this paper is to introduce to the literature a new source of information on ancient boat and rig designs. This source is the information encoded in rock-art depictions of watercraft. This paper provides a technical appraisal of 18 images of watercraft from the Tutuala region of East Timor.

Key words: rock art, maritime technology, South-East Asia, Pacific, East Timor.

The South-East Asia-Pacific region contains many thousands of islands, large and small, some with vast uninterrupted stretches of ocean separating them from the next island target. Ancient boats were not only essential for the initial colonization of this region but subsequently for maintaining communication between distant communities, as is shown by archaeological finds of exotic materials such as obsidian, demonstrating continuing maritime back voyaging and links within the region. No doubt this accounts for the central role played by boats in the cosmology of the inhabitants of this island realm. Boats are among the most dominant and enduring of motifs depicted in a variety of media in South-East Asia and the western Pacific, appearing sculpted in bronze and as representations on textiles, bronze drums and other vessels, and extensively in the painted rock art (Röder, 1956; Röder, 1959; Harrisson, 1958a and b; Ballard, 1987; Kosasih, 1991; O'Connor, 2003). They also play an integral role in the spatial and structural configuration of houses and villages on many islands. The symbolic significance of boats in clan construction, mortuary rites and other rites of passage and has been widely described (for example, Manguin, 2000) and recently reviewed by Ballard *et al.* (2003). To some extent, however, the symbolic role of boats has overshadowed their functional importance within the region and the potential information that such representations and images may encode about early maritime technology.

The role of maritime technology

While archaeological and palaeo-environmental data has now allowed a relatively detailed chronological reconstruction of the colonization of the South-East Asia-Pacific region, there remain many unanswered questions about the colonization process. Such questions include the degree to which colonization voyages were intentional, the range of island targets available to voyagers, and size of colonizing populations, and the regularity of

inter-island contacts post-colonization, among others. Information about past boat-hull and sailing-rig technology is of central importance in the quest to address these questions.

To date, archaeological evidence of past maritime technology in the region is sparse and patchy in both space and time. Only fragmentary archaeological remains of boats have been recovered in Oceania. None of those remains pre-dates 800 BP, and sail and rigging portions of the boats were not preserved (Sinoto, 1983). The situation is considerably better for South-East Asia, where a number of archaeological boat remains have been discovered, the earliest of which dates to about 1700 BP (Manguin, 1989). In China, recent finds have now demonstrated the existence of dugout-canoe technology by 8000 BP, and possible evidence for outriggers and woven-mat sails (Jiang and Liu, 2005).

In the absence of direct archaeological or documentary evidence, researchers have relied on a variety of secondary and proxy lines of evidence to infer past boat technology. Relatively reliable secondary evidence comes from ethnohistoric documents about boats, the earliest of which date to the 17th century AD in the Pacific, and to the late first millennium AD for Island South-East Asia from Chinese sources (Manguin, 1980; Manguin, 1989). Proxy evidence has included geographical distributions of contemporary and historically-recorded boat types (Haddon, 1920; Hornell, 1920a and b; Haddon and Hornell, 1975; Horridge, 1986) and linguistic reconstructions (Pawley and Pawley, 1994).

This direct and secondary evidence for ancient boats and sailing rigs has been most commonly used as a component of predictive colonization models for the South-East Asia-Pacific region. Considerable progress has been made with these models, which for three decades have used increasingly powerful computer technology to manipulate a large number of variables (Levison *et al.*, 1973; Irwin, 1992; Horridge, 1995). Continued refinement is still needed, however. As more reliable and relevant data for wind, ocean currents, seasonal and long-term climate variability become available, these should be incorporated into the models. Another set of variables of central relevance which could be refined are the values used for absolute boat-velocity on various points of sail and seaworthiness.

In currently-published models, researchers have used values for boat-velocity derived from boats known from contemporary or historically-recorded examples. Models of Pacific voyaging and colonization, such as those proposed by Irwin (1992), have been criticized because assumptions about boat-speed and upwind-sailing ability have been derived from what some believe to be unrealistic or inaccurate analogies. In his computer-model scenario for Pacific colonization, Irwin used average speeds as fast as those attained by the *Hokulea*, a 1970s experimental reconstruction of a double canoe, the design for which was developed from ethnohistoric documents. Anderson (2000) believes that it is unlikely that boats built with ancient technology and materials would sail as fast or as close to the wind as the *Hokulea*, which was made with 20th-century materials and tools. Changing the variables used for speed, upwind-sailing ability, leeway and ability to weather storms would significantly alter the predictive results of Irwin's model, with implications for understanding of the process of colonization and interaction in the Pacific.

In defence of Irwin (and other modellers), the variables used represented the best available at the time, and these models allow for refinement as new data become available. Furthermore, his variables have the advantage of being derived from actual boats used in real sailing conditions. What are needed are additional experimental reconstructions using close approximations of ancient designs, materials and tools. However, it is quite possible that most or all boats and rig-types used in prehistoric times in the South-East Asia-Pacific region have completely disappeared from the record, and that those recorded by Europeans in the 17th century may have been relatively recent innovations (Anderson, 2000). The purpose of this paper is to introduce to the literature a new source of information on ancient boat and rig designs. This source is the information encoded in rock-art depictions of watercraft, specifically those in the rock art of East Timor.

East Timor rock art

There are a number of rock-art sites in Island South-East Asia (Kosasih, 1991; Ballard, 1992; Chazine, 2005; Pyatta *et al.*, in press), but one of the richest and most diverse concentrations of painted rock art yet found is near the small village of Tutuala, at the eastern end of East Timor (Fig. 1). This area is characterized geologically by Pleistocene uplifted marine terraces in which limestone caves and overhangs are common. The rock art of this region was first recorded by Portuguese scholars (Cinatti, 1963; Almeida, 1967)

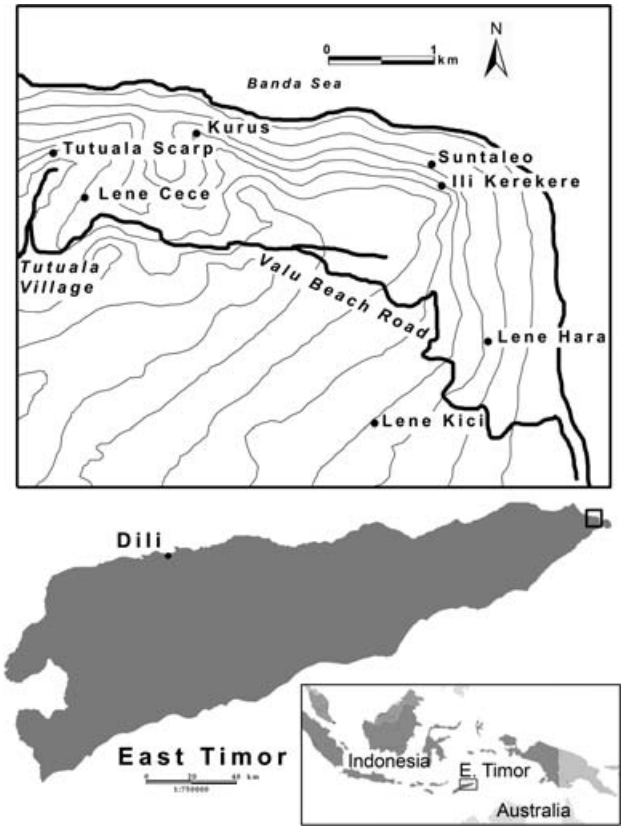

Figure 1. Map of East Timor and sites mentioned in the text.

Figure 2. Lene Hara. (Sue O'Connor)

who described six sites containing images of small anthropomorphic figures, boats, a variety of animals, and geometric motifs. A recent publication documented a further seven painted-art sites in this area, recorded in 2000 and 2001 (O'Connor, 2003). Two further field seasons (2002–2004) have resulted in the recording of many more sites containing painted motifs, of which several contain images of boats. With a few exceptions, the sites command good views of the sea, but most are too distant from the coast to be visible by viewers on passing boats. While most of the painted sites with panels facing the sea are within narrow overhanging limestone terraces which have little or no sediment development, a few deeper cave-sites with substantial cultural deposits also contain painted images (O'Connor, 2003). These large solution caves do not have coastal views.

One such cave, Lene Hara, was first recorded and excavated by the Portuguese anthropologist de Almeida (Almeida and Zbyszewski, 1967). New excavations conducted here in 2000 revealed evidence of human occupation dating between about 30,000 and 35,000 years BP, overlain by a thin late-Holocene occupation unit (O'Connor *et al.*, 2002). Further excavations at Lene Hara and within three other caves, carried out between 2001 and 2003, have now provided a fuller chronological sequence spanning the period from 35,000 BP up to the late Metal Age (*c*.500 BP) (Spriggs *et al.*, 2003; O'Connor and Veth, 2005; Veth *et al.*, 2005). Stone-walled, fortified open sites located on limestone terraces in this area have recently been dated to the 1000–100 BP era (Lape, 2006). Interestingly, while there is little emphasis on fishing or other maritime subsistence activities in East Timor today, the faunal remains preserved in the Pleistocene horizon indicate a heavy reliance on marine resources; shellfish and marine turtle occur in the lowest levels. Boid snakes and large endemic rodents were also exploited at this time. Evidence of a simple flake industry with few retouched artefacts was recovered from the Pleistocene horizon. The Holocene levels of the cave revealed a greater diversity in the fauna with the appearance of the marsupial cuscus *Phalanger orientalis* at about 9000 BP. This species must be a human translocation from the east, originally from New Guinea. Fish, shellfish and turtle continue to be exploited into the early Holocene and a range of shell artefacts, including fish-hooks and drilled beads, appear at this time. A direct AMS date on the lowest hook (and beads) has returned a figure of approximately 10,000 BP, clearly pre-dating any Austronesian techno-complex (O'Connor and Veth, 2005). The style and size of the hooks indicates their use in offshore-reef fishing. No trolling-hooks have been found yet, but the remains of large individuals of pelagic species such as tuna demonstrates that

pelagic fishing was also practiced by the occupants of these sites in the past. It is likely that this type of specialized offshore fishing would have been undertaken from boats. Stone artefacts continue into and throughout the Holocene with no evidence of major technological change. Two other cave-sites, Matja Kuru Caves 1 and 2, have similar occupation histories. These caves facing south over Lake Ira Lalaro are over 8 km from the coast today and would have been even more distant in the Pleistocene (Spriggs *et al.*, 2003). As might be expected they reflect a greater subsistence focus on terrestrial resources than Lene Hara. Pottery makes an appearance in all the caves approximately 3500 years ago, and domestic animals such as pig and dog occur at, or shortly after, this time. However, the sample size of domestic-animal remains from the cave-deposits is too small to render certainty to the timing of their introduction. It would seem that even during Neolithic times the archaeological cave records reflect the hunting and foraging of wild resources.

Relating the painted art to occupation sequences in the caves is difficult. The images themselves give few hints of any relationship and there is little ochre found in the archaeological deposits. By far the most common images portrayed in the shelters are geometric motifs based on rayed or divided circles and scrolls, followed by small anthropomorphic figures shown in frontal and profile positions, boats and some creatures such as lizards, fish, birds and domestic animals. Many of the anthropomorphs have elaborate headdresses and are holding weapons or other objects. Combinations of zoomorphic and anthropomorphic figures are also portrayed. Hand-stencils also appear in some of the sites. Most images are in red pigment, although yellow, orange and brown pigment are used in some motifs, and charcoal motifs also occur singly and in combination with ochre (O'Connor, 2003). We have not yet confidently dated the East Timor paintings themselves, and with the exception of Borneo, no direct dates have been obtained for any of the painted art in sites in South-East Asia (Chazine, 2005). However, it may be possible to date some of the Tutuala images in the future. Several black-pigment images are probably drawn with charcoal and may have dating potential using the radiocarbon technique. Recent attempts to date natural calcite deposits such as those that partly overlie some of the painted rock art in the Tutuala region have met with great success. Uranium series dating on spalls of calcite skins from the wall of Lene Hara Cave has been trialled and demonstrated that reliable ages for finely-laminated carbonate deposits bracketing red pigment can be obtained (Aubert *et al.*, in press). This method has not yet been tested on any of the visible rock-art motifs but holds promise for the future.

The East Timor painting-sites share many features with other painted sites in the broader western Pacific region (Ballard, 1987; O'Connor, 2003) and have been argued by Ballard (1992) to fit within the 'Austronesian painting tradition'. If this is indeed the case the images must post-date the theorized spread of Austronesian-speaking agriculturalists into Island South-East Asia, which would place their execution within the last 4000 years according to current models. Some of the East Timor motifs suggest even more recent or historic origins; the horses and riders in the Ili Kérékéré site being one such example (horses are believed to be a post-AD-1500 introduction to Timor). The motifs recently dated in Borneo have produced a range of Th/U and 14C ages with a minimum age of *c*.9800 BP (Plagnes *et al.*, 2003). Stylistically, however, these painted images are very different from the corpus of art earlier described from Sarawak such as the painted motifs at Niah cave and Gua Sireh (Harrisson, 1958b; Datan, 1993; Chazine, 2005) which include stylistically-comparable boats and anthropomorphs to those from East Timor. In contrast, the early-Holocene Borneo paintings consist predominantly of infilled patterned hand-stencils which are themselves often placed in combinations or joined by painted lines to form larger decorative patterns (Chazine, 2005).

Contemporary meanings are ascribed to some of the East Timor images by members of a local clan, *Tutuala ratu.* Such images include the scrolled geometric motifs (O'Connor, 2003) which are consistently identified as *poko (Fataluku)* and the rayed circles identified as *faria. Poko* translates as a square-sided basket or grave, and we have been told that *faria* are the eye-blinkers on horse-bridles, so the relationship between the contemporary meaning and visual motif is not immediately apparent. While the images have contemporary meaning, they are not ascribed to human action. All images with the exception of the boat-images are believed to pre-date humans, to have put themselves onto the rock or to have appeared on the rock as the land emerged from the sea. The watercraft do not have the same status as the other images and are said to depict the craft of arriving foreigners. The rock-art site Ili Kérékéré has seminal status—

Figure 3. Kurus. (Sue O'Connor)

it is said to be the first place to be occupied by the first people when the land first emerged (Pannell and O'Connor, in press). These first people made candles of beeswax and lit them to announce their presence to foreigners and to attract them to the land. The foreigners came and when they landed around the coast of Tutuala they were given land that they could use. Their boats turned to stone. The boat images are said to be representations of the boats of these foreigners.

Technical appraisal of the watercraft

Among the corpus of rock art in the area of Tutuala there are 18 images which show watercraft, or are plausibly interpreted as representations of watercraft. Included here are drawings made from original colour digital photographs (high-resolution digital files of the original photographs and the black-and-white drawings can be found at http://faculty.washington.edu/plape/etboats/). Where the motifs were difficult to distinguish they were enhanced in Photoshop using associative and disassociative selections and excisions of colour. In this way residual or faded pigment was able to be distinguished without augmenting or reconstructing the form of the original motif. Several of these images are fairly severely effaced with significant lacunae caused by spalling off of the rock surface. Some are small and simple images: for example Kurus appears to have lost one end of the hull and is lacking in detail, while Ili Kérékéré 7 has so little detail that it is an abstract profile of boat rather than a depiction of a boat.

Lene Cece 1 is finely detailed and Lene Cece 2 is somewhat less-finely executed, while all the others have been executed with a relatively-broad brush, finger or other implement. Alternatively, gradual abrasion of the pigment has blurred the images. Lene Hara 1 is different from all other

Figure 4. Lene Cece 1. (Sue O'Connor)

Figure 5. Lene Cece 2. (Sue O'Connor)

Figure 6. Suntaleo 1. (Sue O'Connor)

examples, both in execution and in the style of the watercraft depicted, it is discussed separately. Ili Kérékéré 4 is also different from the other images: it is executed entirely with charcoal rather than ochre pigment, and there are lines and elements in the drawing which do not fit the interpretation that it is a drawing of a watercraft. For that reason no detail can be read unambiguously and Ili Kérékéré 4 is not included in the analysis below. Suntaleo 1 and the example from the Tutuala scarp are the examples where two vessels are shown together. While all other examples depict vessels in a formal profile, these two examples, Suntaleo 1 especially, can be read as views of a scene from a vantage point of some height—the viewer is looking down into the hull of the closer

Figure 7. Tutuala Scarp.

vessel in Suntaleo 1. This might be regarded as a relatively-modern artistic device.

Hull profiles

The depictions can be grouped in various ways, the most obvious feature being the shape of the profile of the hull. The majority of the images show watercraft with very high prow and stern finials. These finials stand near vertical, in some cases recurving in towards the middle of the vessel, and they curve smoothly into the profiles of the stem and sternpost (or the ends of the hull if there are no actual stem and sternpost) giving a crescent-like profile. They resemble the *mon* of the Solomon Islands, the Yami canoes of southern Taiwan, and vessels including the *orembai* from neighbouring southern Maluku (Kano and Segawa, 1945; Haddon and Hornell, 1975; Horridge, 1978; Barnes, 2002). Significantly those are three types of vessel built by Austronesian-speaking peoples which exhibit the lashed-lug construction technique which is known from archaeological data to be of considerable antiquity. The *mon*, the Taiwanese Yami canoes, and the *orembai* are considered to be watercraft which represent designs of remarkable longevity.

Five, or perhaps six of the depictions show vessels which do not have the same crescent-like profile: Lene Cece 1 and Lene Cece 2, in which the prow and stern finials are less integrated with the profile of the hull; Ili Kérékéré 6 has a stern finial which curves smoothly into the profile of the stern, but the prow finial stands erect and meets the bow profile at a distinct angle; the vessel lower left in the pair at Suntaleo 1 appears to lack a stern finial; Suntaleo 2 can be seen as intermediate between the crescent profile and that of Lene Cece 1 and 2; Ili Kérékéré 2 can be read as having a bifid bow with a lower projection flowing into the curved profile of the hull and an upper finial raked fairly sharply forward. However, the image is rather faint and the lower projection might be a mistaken reading. Similarly, Ili Kérékéré 5 might have a lower spur in the bow profile.

In most examples the two ends of the hull are very similar. It is possible positively to differentiate the bow from the stern when the rudder or steering oar/paddle is shown because this will always be at the stern. In Ili Kérékéré 8, Lene Cece 1, and Tutuala Scarp no steering-device is shown. In the case of Lene Cece 1 it is safe to assume that the bow is to the right so that the crew and figurehead are looking forward.

In Ili Kérékéré 1, 2, 3, 5, and probably 6, the aft finial is somewhat higher than the forward one, though in Ili Kérékéré 1 and 7 the difference is slight. In Lene Hara 1, Lene Kici and Suntaleo 2 the bow finial is higher, but Lene Hara 1 and Suntaleo 2 are anomalous examples: Suntaleo 2 does not have the typical crescent profile, and

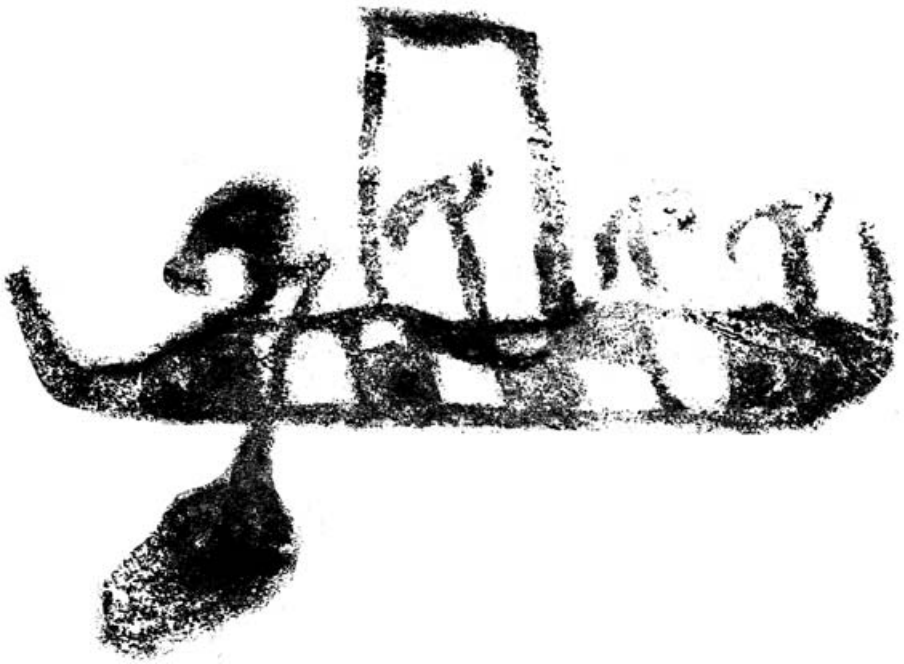

Figure 8. Suntaleo 2. (Sue O'Connor)

Figure 9. Ili Kérékéré 1. (Sue O'Connor)

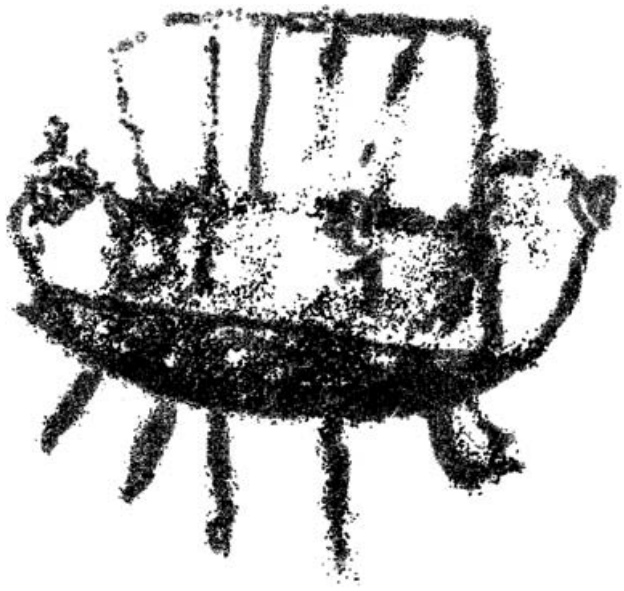

Figure 10. Ili Kérékéré 2. (Sue O'Connor)

Lene Hara 1 is different from all other examples in almost every other detail. If the stern is assumed to be the taller end, then the two vessels in Tutuala scarp have their bows to the right and are being rowed to windward (if those are flags flying), while the similar vessel in Ili Kérékéré 3 has its bow to the left and is going downwind. High stern finials are more common than high bows in the traditional designs of the region. Ili Kérékéré 3 has spiky projections in opposed

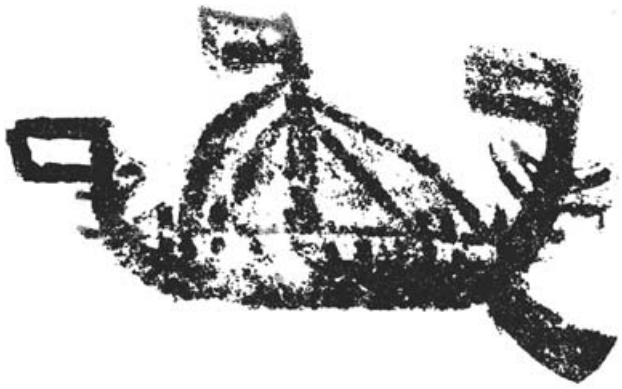

Figure 11. Ili Kérékéré 3. (Sue O'Connor)

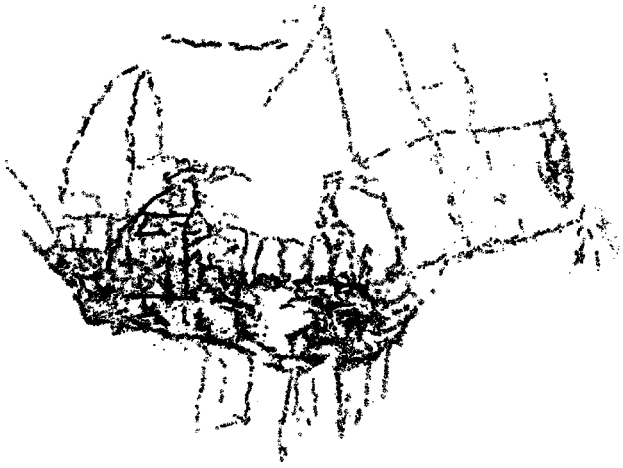

Figure 12. Ili Kérékéré 4. (Sue O'Connor)

Figure 13. Ili Kérékéré 5. (Sue O'Connor)

pairs, pointing both inboard and outboard on the bow and stern finials.

In the immediate region of Timor Leste the most maritime-oriented people are from the off-lying

Figure 14. Ili Kérékéré 6. (Sue O'Connor)

Figure 15. Ili Kérékéré 7. (Sue O'Connor)

islands of Atauro (part of Timor Leste) and Wetar (part of Indonesia) which is separated by the Wetar Strait from Timor Leste. The traditional watercraft of Atauro and Wetar are heavy, flat-sheered, double outrigger canoes with relatively low transoms and vertical finials in the bow and stern. They carry tilted rectangular sails on bipod masts and often have a square hut built over the hull (Anon., 1944: 119). Nothing in the Tutuala rock art looks much like the canoes of Atauro and Wetar.

In most examples the artist has shown the steering device and the curve of the bottom of the hull below the waterline. The obvious exception is Tutuala Scarp. In general, the hulls are shown with very little depth between the rail and the bottom of the keel. In some examples (Ili Kérékéré 3, 7 and 8, Lene Hara 1 and Lene Kici) the depth is so slight that it seems that the artist is showing only the topsides (the hull above the waterline) while showing the rudder below the water, presumably following a local artistic convention. When ratios of depth to length (measured at the height of the rail) are calculated

Figure 16. Lene Kici. (Sue O'Connor)

Figure 17. Ili Kérékéré 8. (Sue O'Connor)

they fall fairly neatly into two groups: ratios between 5:1 and 6.7:1; and ratios close to 10:1. The later ratio is, cross-culturally, a fairly standard ratio for freeboard (height above the waterline), while the lower ratio probably reflects the total depth of the hull (moulded depth). Morphometric analyses used to design a replica of a 19th-century Macassan *perahu* and a 16th-century Dutch *jacht* both gave 10:1 as the appropriate length-freeboard ratio (Burningham, 1987; Burningham and de Jong, 1997). Kurus with a ratio of 7.8:1 is intermediate, but it is a rather simple abstraction with an exaggerated crescentric profile.

Sizes of vessels portrayed

Lene Cece 1 is shown with six persons on the forward deck and another five or six below decks. These human figures vary greatly in size—the largest is about three times the height of the shortest. If the largest is taken as being roughly in scale with the vessel, the vessel is at least 15 m long, and if a smaller figure is chosen for scale purposes, the vessel is longer. On the other hand, Lene Cece 2 could be as little as 5 m in length if the figures standing in the hull are drawn to scale. Suntaleo 2 apparently shows a similarly small vessel and Lene Kici is not very much larger. However, this calculation of size is probably not reliable: the sizes of humans shown on ships are often incorrect, even in relatively sophisticated art. Also, in the Tutuala rock art the relative proportions of other features, such as steering devices, are probably not depicted with realistic scaling as an important requisite. Indeed the rudders are shown implausibly large in most examples, and impossibly large in figures Ili Kérékéré 3 and 6, Lene Cece 2 and Suntaleo 2, while in Ili Kérékéré 7 the thing which has the shape and position of a quarter rudder is as large as the hull it is appended to. In general, the rudders of small craft are large relative to the hull and large vessels have relatively-small rudders (allometric variation) but the variation in rudder-size relative to hull-size depicted at Tutuala greatly exceeds any possible allometric variation. While metrical calculation of size by scaling from human figures or other elements is not useful, it is clear that the ship depicted in Lene Cece 1 is relatively large (the drawing is large too) while Lene Cece 2 is a more modestly-proportioned boat and Suntaleo 2 is probably a small canoe. The majority of the depictions are probably intended to represent vessels of no more than about 10 m long—large boats rather than small ships.

A possible exception is Ili Kérékéré 3, though it is a small drawing with no fine detail. It seems to show a vessel with an upper deck or platform running from bow to stern well above the rail. Both above and below the upper deck there are thick vertical lines which might represent humans, nine of them below the upper deck (perhaps oarsmen) and six on the upper deck. If this speculation is correct, a fairly large vessel is represented.

Sails?

Ili Kérékéré 1, 2, 5, 6, 7 and 8, Lene Cece 1, and Suntaleo 2 all show a quadrilateral shape over the hull, positioned approximately equidistant from bow and stern, though noticeably aft of midships on Ili Kérékéré 1, 2, and 5. This large quadrilateral shape is easily interpreted as a square sail. In Ili Kérékéré 1 and 2 there are vertical lines which could represent the seams joining the bolts of cloth, or whatever the sail is made of (if it is indeed a sail). On Lene Cece 1 there appear to be both vertical and horizontal lines dividing the sails into rectangles which might be interpreted as panels of cloth or woven palm-frond panels like those used in the sails of the *peledang* from Lamalera (Akerman and Dwyer, 2000). The sails in Ili Kérékéré 1, 5 and 8, and Lene Cece 1 are noticeably broader at the head than at the foot, suggesting a sail spread on a yard but with no boom at the foot.

If these depictions really do show vessels carrying a single square sail with no boom, it is a rig that

is highly unexpected in an Island South-East Asian context. Quadrilateral sails are well known, virtually ubiquitous until recent times in the region; but square sails,[1] in the technical sense, are virtually unknown, though the quadrilateral sail of Island South-East Asia can be temporarily set like a square sail when running before the wind (for example in early-19th-century Timor as shown in Godard and de Kerros, 2002: 272).

Almost all the sails of Island Southeast Asia have a boom laced to the foot of the sail. South-East Asian sails are not reinforced to allow a sheet or tack (controlling ropes) to be attached directly to the sail. The load is necessarily spread by a spar of bamboo or wood. The closest known occurrences of boomless square sails to Timor are the Irrawaddy-river rice-barges and traditional cargo-carrying sailing-vessels of Japan. Another type of vessel with a single square sail set aft of midships (as in several Tutuala depictions) and steered with a steering-oar, indirectly connected with Timor through its colonial history, was the type of barge used for transporting port-wine downriver on the Douro to Oporto in Portugal. None of the vessels mentioned here (Irrawaddy, Japanese, Douro river) had high bow and stern finials like those depicted at Tutuala.

The quadrilateral sails of Island South-East Asia (*layar tanja* in Indonesian) are typically very broad sails, spread by long yards and booms, but they have relatively little height when set with the yard horizontal. They are usually tilted to give more height ('peaked up' in nautical terminology) as is implied by the name *tanja* (slope). Most of the quadrilateral shapes shown over the Tutuala watercraft have more height than spread, making them fundamentally different in shape from *layar tanja*. The quadrilateral shape over Ili Kérékéré 2 has a broader and lower shape, more like a *tanja* sail, but it is not tilted like a *tanja* sail.

The images at Kurus, Lene Cece 2 and Lene Kici show a somewhat different quadrilateral erection midships—somewhat aft of midships in the latter two examples while the bow and stern cannot be distinguished in Kurus. In Kurus and Lene Cece 2 the quadrilateral shape is divided by lines running from corner to diagonally opposite corner. In Lene Kici the quadrilateral shape is divided horizontally into three tiers, the upper two of which are each divided diagonally. If a type of sprit-rig is depicted (a sprit is a spar that lies diagonally across the sail it is used to spread) it is a type that has not been recorded previously, and the practicality of such a double-sprit arrangement is far from obvious. There is, however, one depiction of a medieval Persian ship with spars in a similar configuration which has never been satisfactorily interpreted (in the 'Maqamat [compilation] of al-Hariri' 1225–35). The oldest watercraft recovered in China, dated to about 8000 cal. BP, from Kuahuqiao in the Lower Yangzi River region, was found associated with a section of cane or bamboo matting which appears to have been attached in a double layer to a T-shaped wooden frame. The excavators question whether this may be the remains of a sail or alternatively of roofing for some type of structure attached to the canoe (Jiang and Liu, 2005). Liu (pers. comm. 2006) suggested that the central tiered and divided structure above the hull on Lene Kici may have similarly been used to attach double matting. However, as discussed below, it is also possible that the Lene Kici structure is a plan representation of an outrigger.

There is no clear sign of a mast in any of the depictions of vessels with the quadrilateral forms over the middle of the hull, with the exception of a previously-published boat image from nearby Verulu cave which is stylistically quite distinct from the other images described here (O'Connor, 2003). There is a pair of short uprights in Ili Kérékéré 1 approximately where a mast would be, but they are not clearly a mast. There is no rigging shown with the single exception of a line that would be a counter-brace (a line of extra rigging carried by warships which might have braces carried away by gunfire) if the quadrilateral shape represents a square sail in Lene Cece 1.

There appear to be masts and rigging shown in Ili Kérékéré 3 and Tutuala scarp, and while there are apparently flags flying, there appear to be no sails. If there are sails intended, they are jib-headed like modern yacht-sails and poorly depicted, but this seems unlikely. Either there are no sails, or the artists did not understand sails sufficiently to draw details that could convey how the sails were set. This contrasts with the north-Australian Aboriginal rock-art depictions of Macassan *perahu* in which rigging is carefully detailed, and in some cases led around the outside of the sail to avoid fouling the sails, suggesting a strong understanding of seamanship on the part of the artists (Burningham, 1994).

It is possible that the quadrilateral shapes seen in the Tutuala rock art are not sails but the sharply-pitched roofs of house-like structures built on the vessels. In Ili Kérékéré 1, 5, and 8 outward-curving gable-ends, found widely in Indonesia

(and seen on some of the 8th-century Borobudur ship-depictions) are evident—particularly in Ili Kérékéré 8. Gabled roofs are very widely found on watercraft in Island South-East Asia, although they seem to be absent from naval architecture elsewhere. While there are examples of a single square sail set aft of midships it is an unusual arrangement, and unlikely on seagoing vessels. A large deckhouse, on the other hand, is likely to be positioned aft of midships so that the vessel will trim correctly. What appear to be sewn seams of a sail could in fact be the roof structure. The arrangement in Lene Kici could be interpreted as a bamboo tower. The intention in Lene Cece 2 and Kurus is unknown. Perhaps, a patterned *bedeg* wall is depicted.[2]

If the analysis that buildings, rather than square sails, are shown is correct, the roofed structures are large relative to the vessels they are carried by. The relative sizes of the roofed structure and the boats are in most cases implausible for seafaring. Either the roofed structure is symbolically important and therefore emphasised by the artists, or the rock art reproduces a conventionalised symbolic image of a boat carrying a house.

Oars, paddles and rudders

Oars or paddles are shown in Ili Kérékéré 2 and Suntaleo 1. If the persons operating them are facing aft, as appears to be the case, the devices are oars rather than paddles, but the detail is not clear enough to be sure of that interpretation. In Suntaleo 1, the vessel on the left appears to be using oars to pursue and attack the vessel on the right which also has four oars deployed.

In all useful examples (excluding incomplete Kurus) except Ili Kérékéré 8, Lene Cece 1 and Tutuala scarp, a steering-device is evident. The lack of a steering-device in Lene Cece 1 is curious because it is the most finely-detailed depiction in all other respects. In analysing the steering-devices it is helpful to distinguish between rudders, steering-oars, and paddles used for steering. A true rudder is held fixed in position at two or more points and rotates on its longitudinal axis; usually more of the rudder's blade is aft of the axis than is forward of it. In some cases the blade curves aft. On that basis, Ili Kérékéré 1, 2, 3, 6, Lene Cece 2, Lene Hara 1, Suntaleo 1 and 2 show true rudders. Only Ili Kérékéré 5 seems to show a steering-device that has its blade symmetrical either side of the axis of the loom, stock or shaft, suggesting an oar, fixed at just one fulcrum, or a paddle held against the hull, rather than a true rudder. Such an arrangement is only suitable for relatively-small vessels and implies a relatively-archaic stage of technological development in Island South-East Asia. In western ship design, since the late middle-ages, nearly all rudders have been fitted on the median fore-and-aft line of the vessel; but in Island South-East Asia rudders are traditionally fitted off-centre, on one or both sides of the stern (the quarters).

In the Ili Kérékéré iconography, except Ili Kérékéré 3, rudders are shown rather further forward than might be expected (between 25 and 33% of the hull's length from the aft end). There is evidence that rudders were carried further forward in the past (Burningham, 1987: 108–10; Mellefont and Burningham, 1996: 99), but 33% of the hull's length from the stern is probably too far for the rudder to have adequate leverage.

Lene Hara 1

The vessel depicted at Lene Hara 1 is different from all the others in its detail and in the style of execution. It has been drawn with a few bold lines of relatively-even thickness, and there is almost no infilling of pigment between the lines. There are no humans shown on board. Much of the length of the hull is surmounted by a low, square structure—it may be that this is the topsides of the hull built up through most of the length of the hull in a similar way to that seen on the 19th-century Macassan *perahu padewakang* or the *mayang* depicted by Loderwijkz *c*.1600 (Horridge, 1981: 2).

The crescent profile of the hull is somewhat flattened. There appear to be very high feathery ornaments attached to the prow and stern finials. It also appears that two rudders are fitted, on the port and starboard quarters (again like a 19th-century Macassan *perahu* or other vessels from South Sulawesi). It is this depiction that most plausibly shows a sail, or least plausibly shows a roofed structure. It is positioned slightly forward of midships. The posited sail is shown as an inverted truncated triangular shape. It might represent a quadrilateral sail in the Javanese form with a relatively short leading edge, set peaked up vertically for running before the wind. No rigging is shown.

Affinities: Dong Son and others

Lene Cece 1, which is finely detailed, shows human figures in the Dong Son style. This style is associated

with bronze artefacts from Mainland South-East Asia *c*.1000 BC–AD 1, but which continues through later periods in Island South-East Asia. It also resembles the 'ship of the dead' as depicted on Lampung *songket* cloths, particularly in the hull-shape and the figures depicted within the hull, and also the lack of a rudder in an otherwise carefully-detailed drawing. The style of the curved rudders in Ili Kérékéré 2 and 3, and especially Suntaleo 1, is reminiscent of vessels depicted on some Dong Son kettle-drums (Sorenson, 1986). The profiles of the hulls and the bow and stern finials are reminiscent of the bow and stern finials shown in some Dong Son ship depictions. However, the majority of Dong Son ship-depictions show relatively simple ends to the hulls. None of the Tutuala depictions has the appearance of great length relative to depth that the vessels on Dong Son drums have.

A bronze model of a ship, said to be Bronze-Age in origin although possibly imported via long-distance exchange from mainland Asia, is known from Kampong Dobo, Flores (Spennemann, 1985). It has a bifid bow profile unlike any shown at Tutuala except, possibly Ili Kérékéré 2 and 5, but the stern is rather more similar to Tutuala depictions and has a decorative finial like that of Ili Kérékéré 5. The model carries an armed figure in the bow very much like some drawn at Tutuala, and like those depicted on Dong Son watercraft. It has high platforms at bow and stern and a lower structure with a larger base amidships; it is evident that this midships structure is incomplete and may well have been higher when intact. It might be the quadrilateral structure shown on several Tutuala boat drawings.

In the neighbouring region, southern Maluku, there is a tradition of building extraordinarily-long canoes (variously known as *belang, bele bela, kora kora*) for racing and ceremonial use, though they were probably used as war-galleys in the past. These vessels have very high, curving bow and stern finials, much like some shown in the Tutuala drawings. However, the Tutuala drawings show finials which are even more extremely high relative to the hulls they are fitted to. As noted above, relative proportions are not reliable in the rock art, so the extremely tall finials might be an artistic exaggeration.

Discussion and conclusions

The Tutuala nautical rock art appears to be 'pier-head' art rather than the work of seafarers. The artists show no concern with the operation of sails, and it is not certain that there has been any attempt to depict sails. On the other hand, some of the depictions do show that the artists understood the design of rudders and their shape below the waterline. The fact that most of the steering-devices appear to be true rudders, rather than oars or paddles deployed for steering, suggests that the vessels depicted post-date the populating of western remote Oceania by Austronesian-speaking people, because true rudders are historically absent in that region and further east. However, true rudders may have disappeared from the region before their documentation by 17th- and 18th-century explorers.

This ethnohistoric and linguistic evidence also suggests that the migration of early Austronesian-speaking people to the region was made on vessels that used outriggers or double-canoe configurations to provide stability to narrow hulls. Linguistic reconstructions and the analysis of historically known traditional watercraft of the Pacific have been used to argue that wide-beamed hulls were unknown when Austronesian-speaking people moved into the Pacific, although this may merely be the result of absence of evidence. The Tutuala iconography does not show any definite outriggers, although it is possible that one is depicted in Lene Kici. Outriggers are difficult to depict—in effect they are only clearly visible in plan view. Australian Aboriginal depictions of Macassan vessels show much technical detail, but the large canoes which the Macassans brought to Australia for *tripang* collecting are not shown with outriggers although it is almost certain that they had outriggers. At Lene Kici the narrow divided structure shown above the hull may actually be an attempt to depict an outrigger in plan view, with the rest of the canoe shown using the usual convention of profile view. The excavators of the 8000-year-old canoe from Kuahuqiao in China have suggested that wooden timbers found separate from the canoe hull, and off to one side, may be the remains of an outrigger (Jiang and Liu, 2005: 3–4). However, as there is no mention in their report of attachment holes in any of the timbers, and the upper section of the canoe, which would have supported the outrigger is missing, this claim must be regarded as speculative.

The possibility that some of the vessels are depicted with houses erected midships suggests that these were vessels fitted for the transport of important personages, and that the ceremonial or symbolic load carried by some of the vessels

was significant to the artists. The contemporary explanation of the watercraft depictions, provided by the people of Tutuala—that they are the boats of foreigners who came to Timor and were given land—is interesting. There is some parallel with the myth of *Sariwigading* bringing the design of large (outriggerless) watercraft (a design of divine inspiration) from foreign parts to Sulawesi (Horridge, 1979: 10). The people of Tutuala today are non-Austronesian speaking, so it is tempting to equate the foreigners with the arrival of Austronesians, but for reasons given above the watercraft do not fit the inferred design of early Austronesian vessels. There is also some documentary evidence that in the historic past the area was linguistically Austronesian but that recent language shifts have seen the adoption of non-Austronesian languages (O'Connor, 2003).

Alternatively, the Tutuala rock art might depict the arrival of Bronze-Age mariners from mainland South-East Asia. Perhaps some or all of the depictions are contemporary with Dong Son trade to the region. Certainly there are stylistic affinities with the ships depicted on Dong Son drums, and the Bronze-age boat model from Flores, but there are also affinities with much more recent vessels in the region. Indeed, it can be argued that Dong Son artistic culture persists in the region, most obviously in the bronze kettle-drums used on Alor, across the Ombai Strait, into recent times, and in the motifs used in weavings and wood carvings in Timor and elsewhere. As noted above, Suntaleo 1 seems to exhibit an understanding of perspective, with the vessels receding obliquely across the composition and viewed from a high vantage-point. This would seem to imply influence from a major and relatively recent artistic tradition, perhaps western or Chinese.

It may be that the vessels depicted, in some cases at least, are not direct representations of vessels observed on the sea, but representations of vessels as represented in other artworks such as Lampung cloths, decorated kettle-drums, and wood-carvings (for example Taylor *et al.*, 1991) thus making explicit and simultaneously collapsing to a singularity an infinite regression of meaning.

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Notes

1. Square sails are defined by setting square (at right angles) to the fore-and-aft line of the vessel when at rest. They can be braced round to lie nearer fore-and-aft when the wind directions makes that appropriate. Either of the vertical (or near-vertical) edges of a square sail (the leeches) can be the leading edge. Either of the lower corners (tacks) can be the windward tack. There have been examples of square sails that were triangular in shape. Fore-and-aft sails, by contrast, lie approximately along the fore-and-aft line of the vessel when at rest, they have only one edge which is intended to be the leading edge (the luff), and only one lower corner intended to be the tack.
2. *Bedeg* or *deg* is woven bamboo laths, widely used in house-building in island South-East Asia. Laths with the outer skin of the bamboo can be interwoven with laths split from within the bamboo to produce decorative patterns.

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