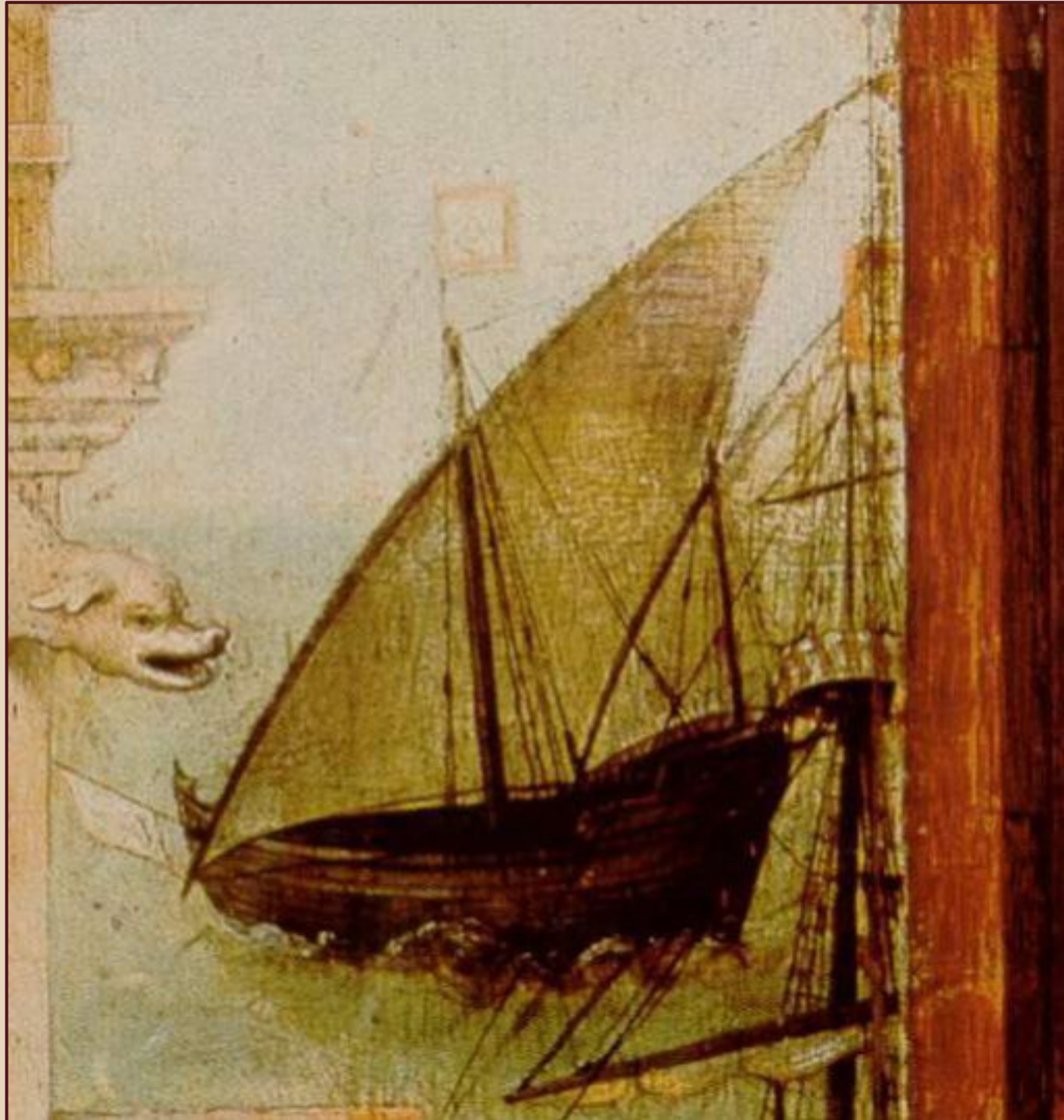


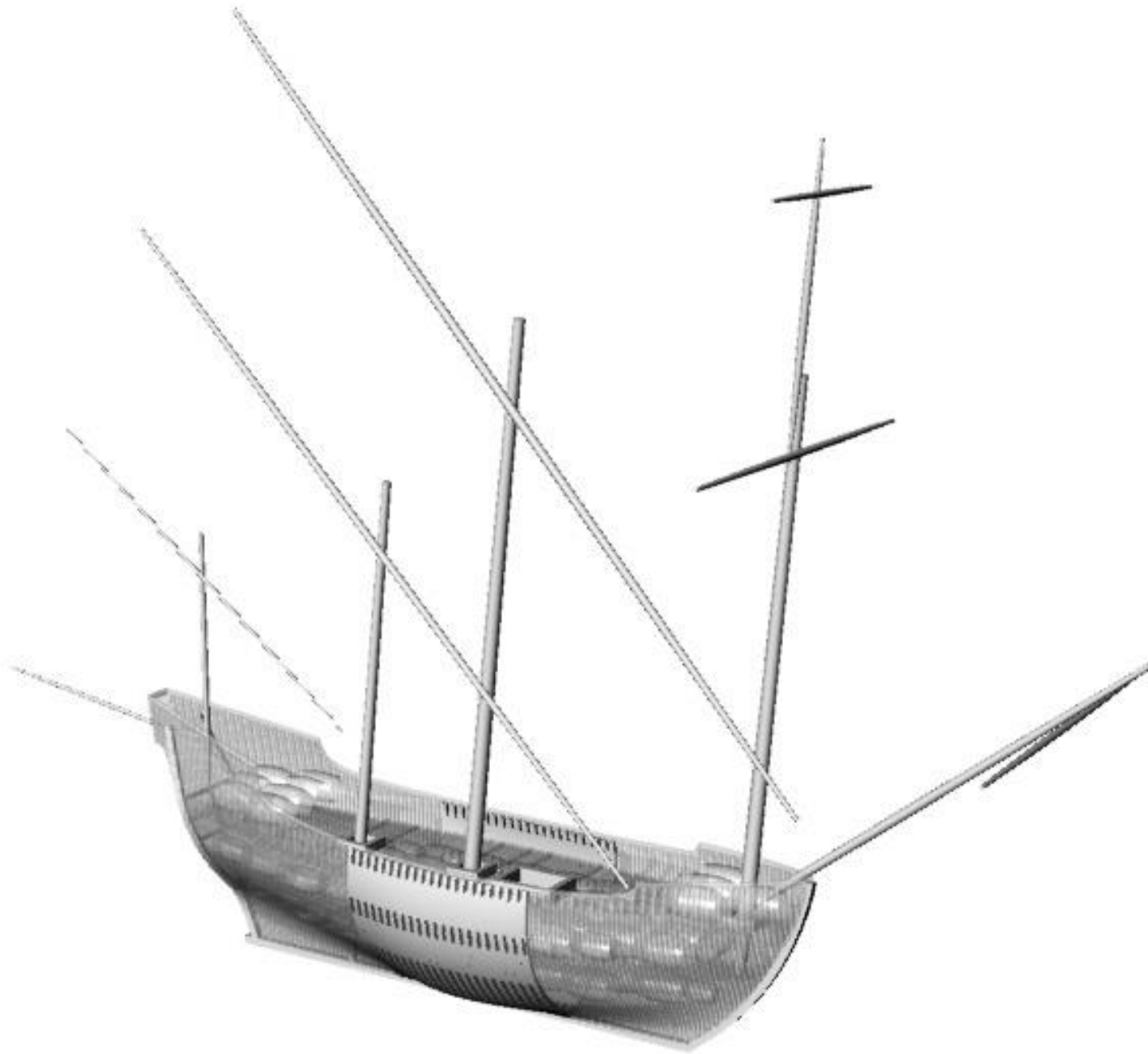
Caravels, European Ships in the New World

Direção Regional de Cultura do Algarve
Projecto MAGALLANES_ICC

22 de Julho de 2022

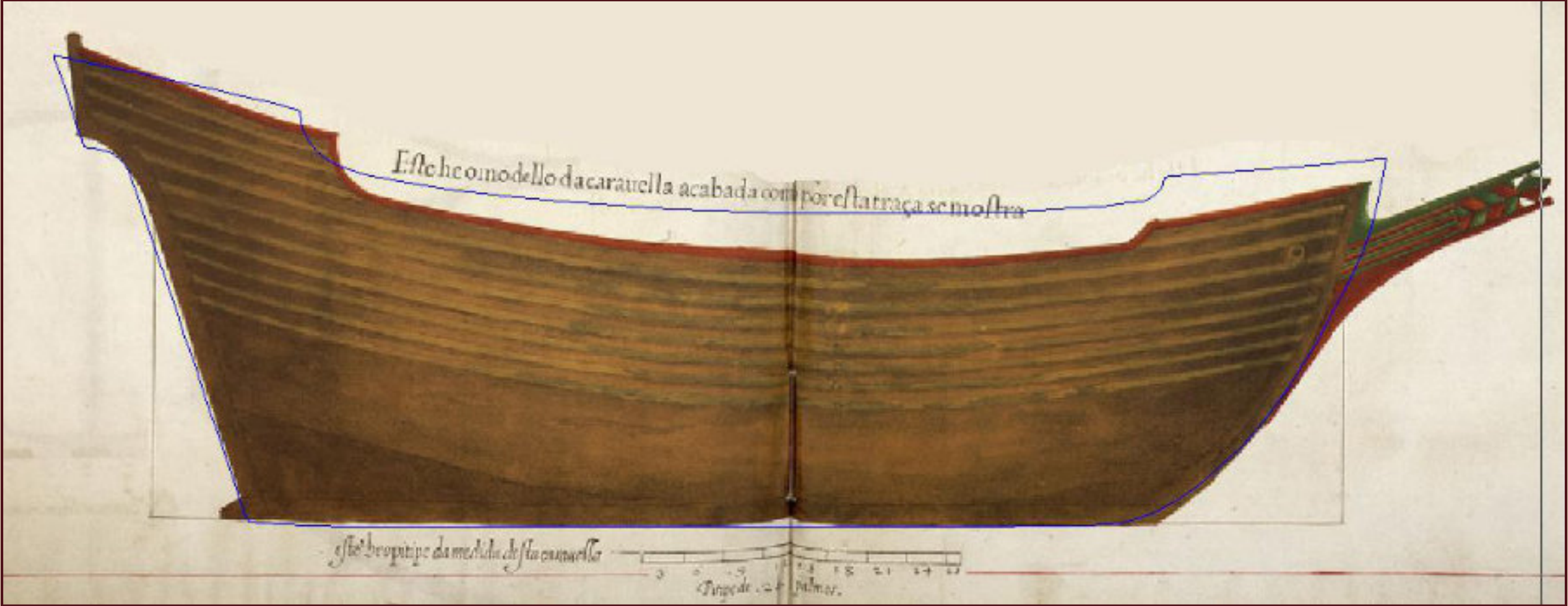
Filipe Castro
Universidade de Coimbra



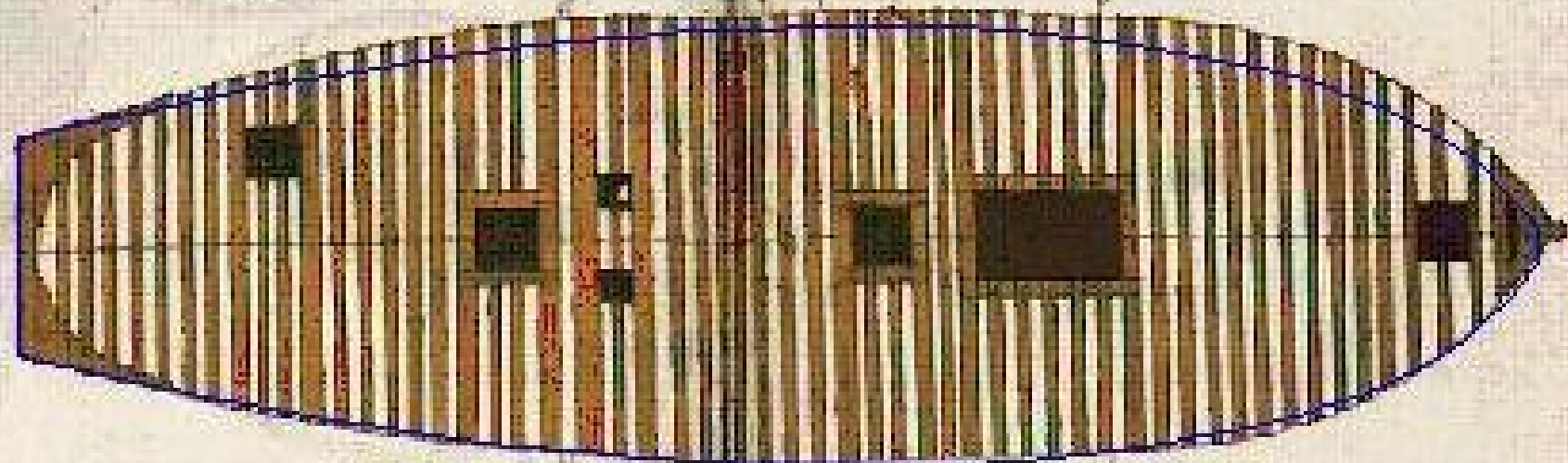


Part of my contribution for ForSEAdiscover was this summary of what we know about the main types of watercraft used in Portugal and Spain in the 1400-1700 period. This talk resulted from an attempt to reconstruct a 1616 **caravel** with computer simulation tools.

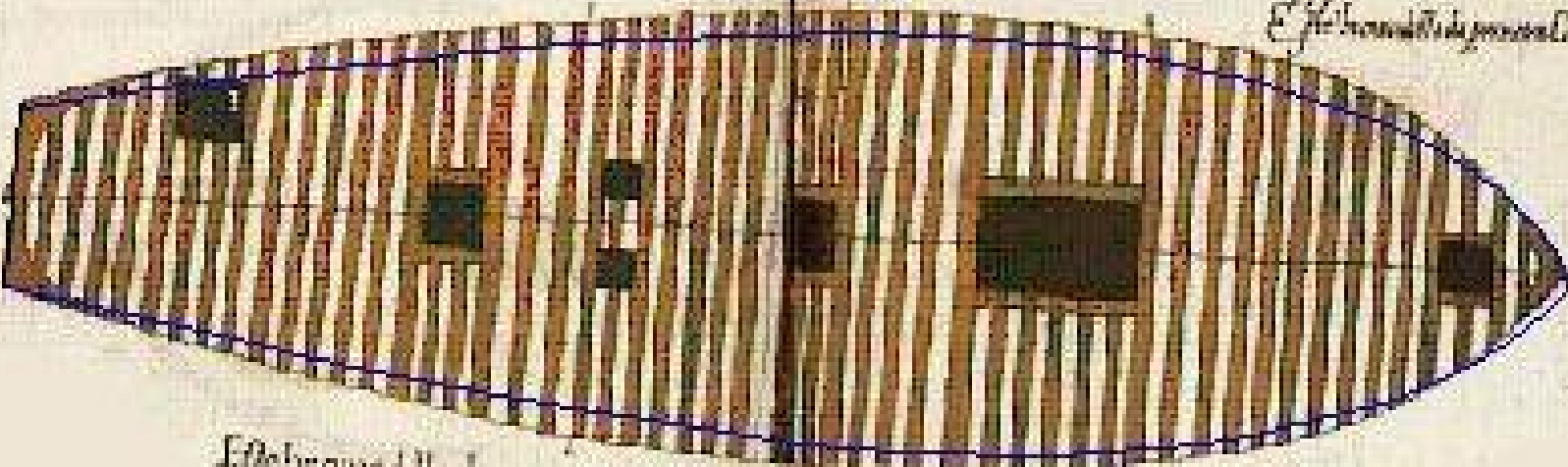
Although caravels are referred in literature since the 12th century, the 1616 double-decked caravel represented in Manoel Fernandez is the earliest model of a caravel.



Este es un modo de hacer el casco de un navio de guerra
y es el modo de hacer el casco de un navio de guerra

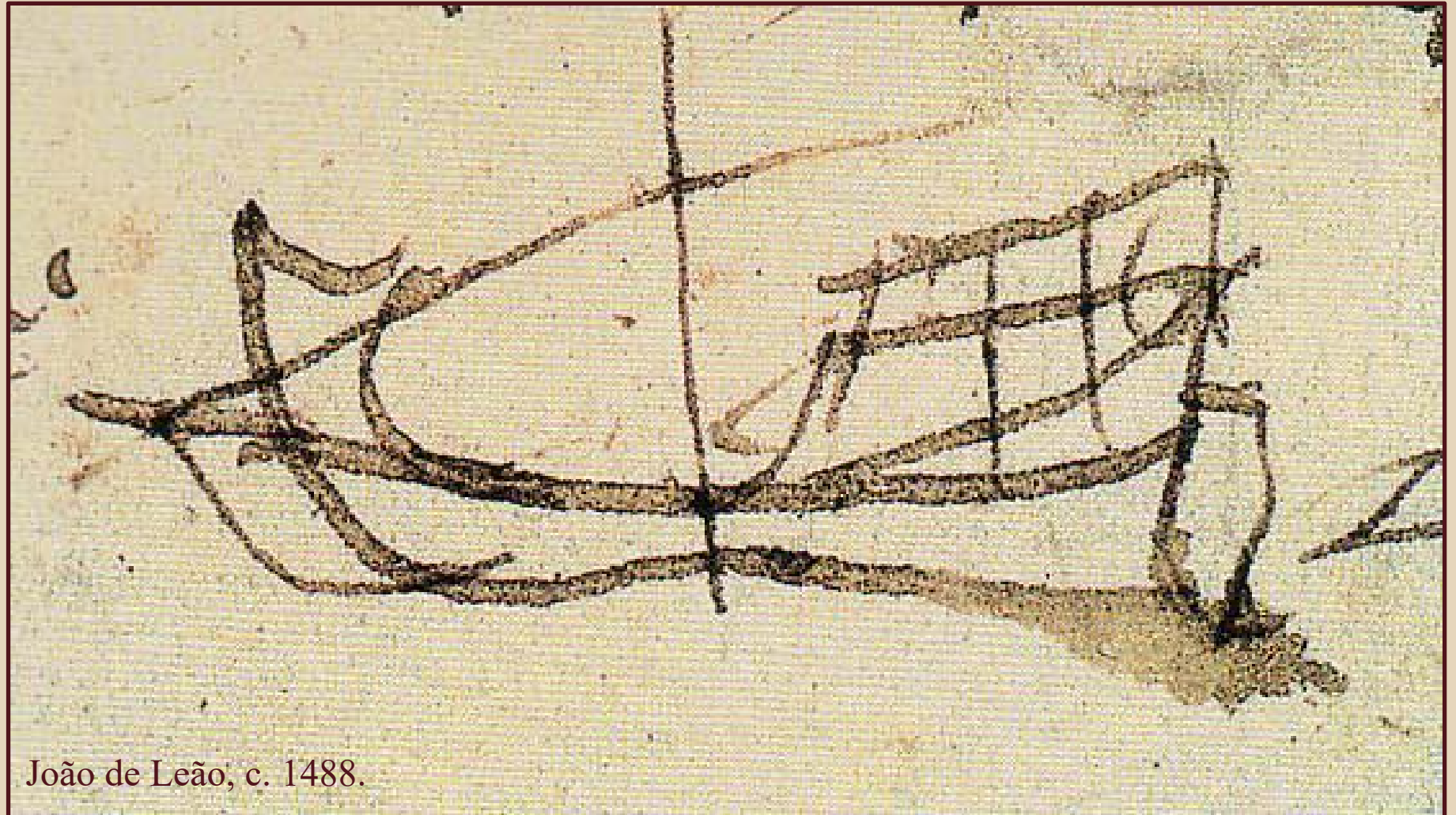


Este es un modo de hacer el casco de un navio de guerra



Este es un modo de hacer el casco de un navio de guerra
y es el modo de hacer el casco de un navio de guerra

Nobody knows what the caravels of the 1440s, 1460s, and 1480s looked like. There were many types of lateen-rigged boats and ships in the 15th century, some with stern castles.



João de Leão, c. 1488.

Before 1500 we can only guess. All we have to work with are a few textual references:

1. Boats named *Carávos*;
2. Two 12th century Italian references to a type of boat called *Caravellum*;
3. The 13th century *caravelas* in the *Foral de Gaia*, Portugal;
4. The 15th century *caravelas* of the discoveries;



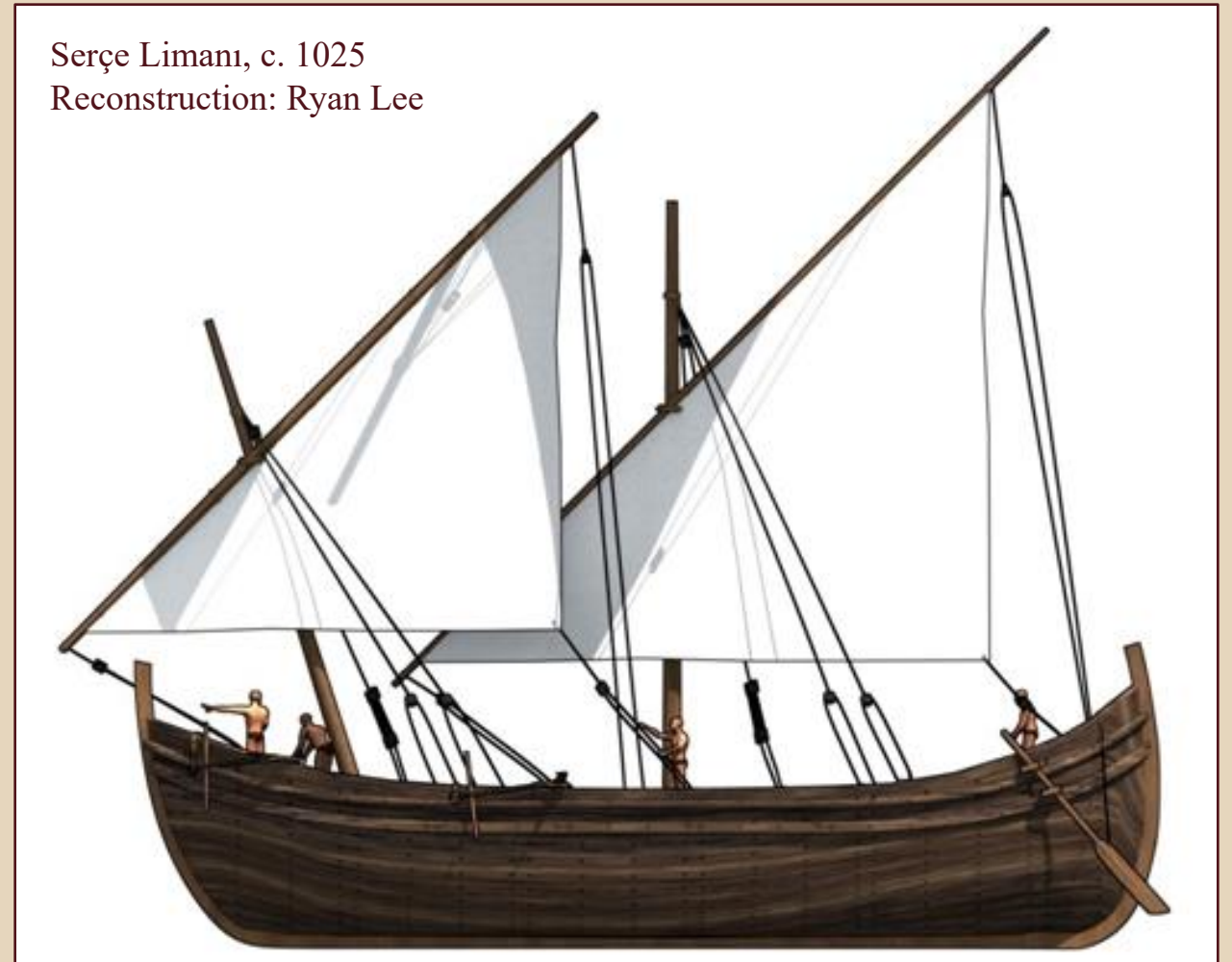


1. *Cáravo*

Jal and Corominas explored the origins of the words *cáravo* and *qârib*, both referring to small boats, sometimes coracles.

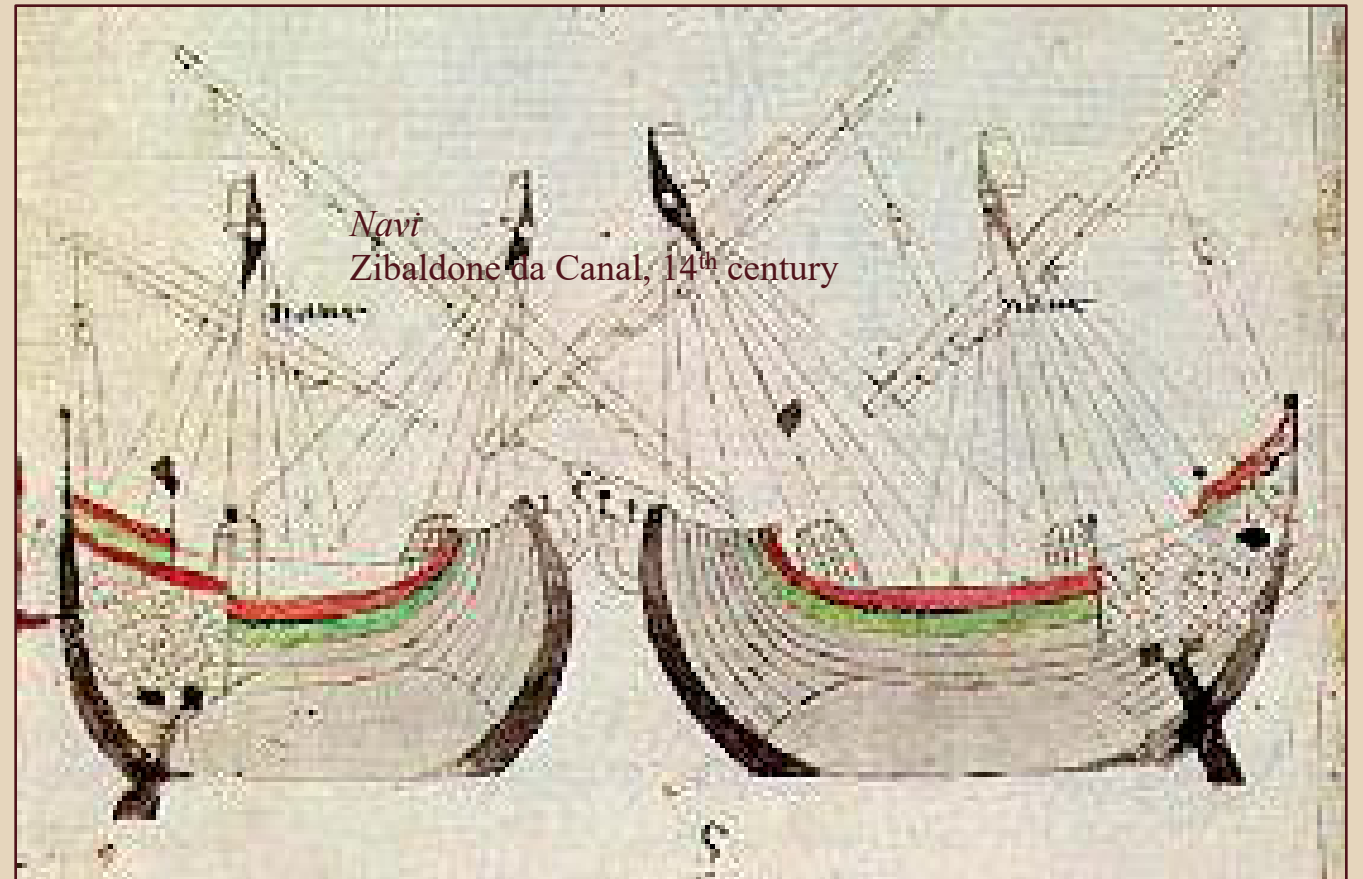
2. Caravellum

There is no way to tell what kind of boat was the 1159
Genoese *caravellum coopertum*.



These boat/ship type appears in Genoese documents in the 12th century, the first mentioned as decked (*coopertum*) serving a *navis* (1159), and the second (1190) very small (cheap), belonging to a *caravelator*, presumably working in the harbor (*barqueiro*).

Furio Ciciliot points out the fact that in the 12th century the word *caravelum*, referring to a small boat, is masculine and does not become feminine until it is assimilated to a larger vessel: *navis sive caravellae*.





I am not aware of any representation of a caravel in Italy before the late 15th century.

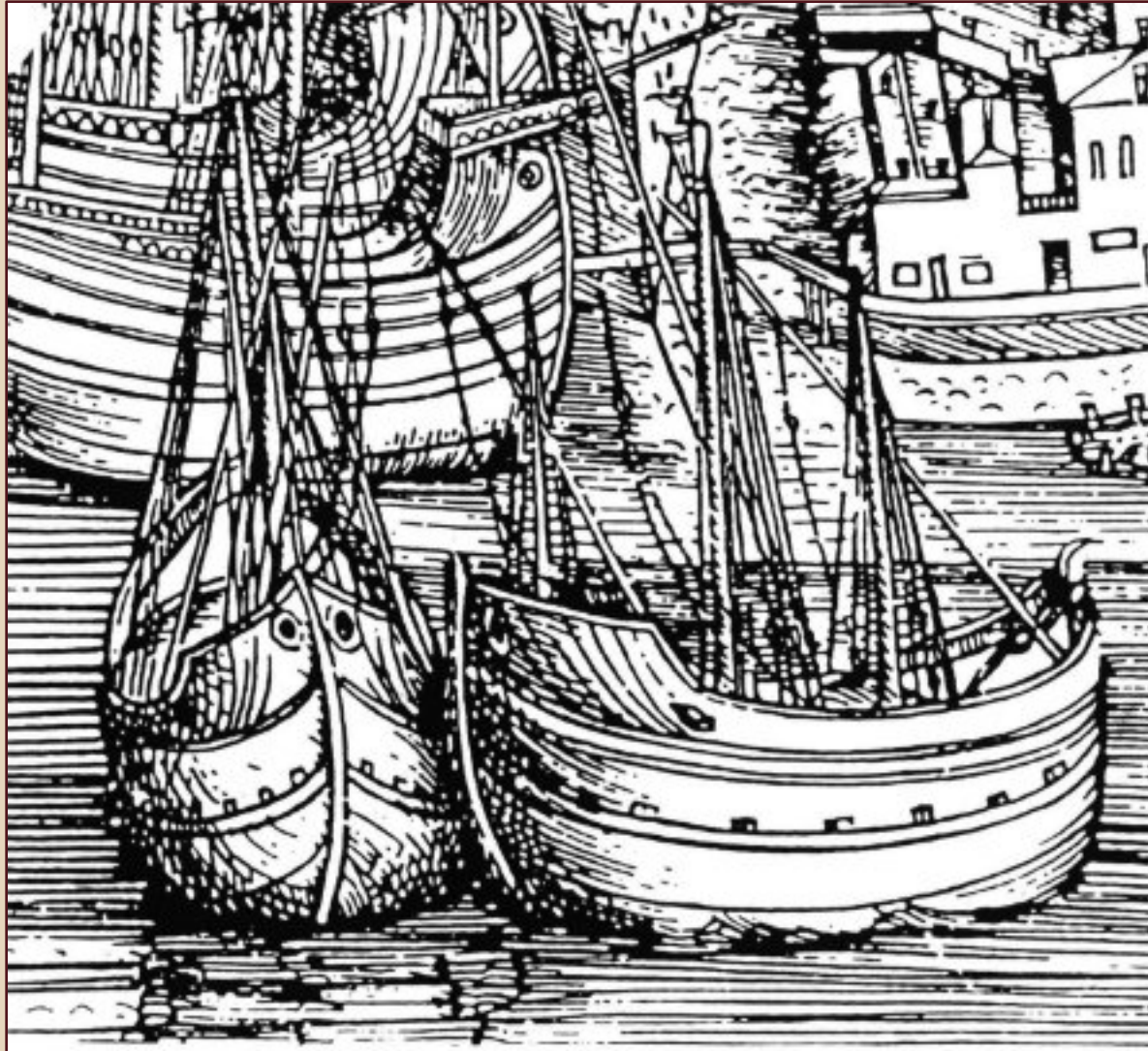
Image of an Italian one-masted
lateener (?) (a caravel?)
1499, Liguria

Jacopo Barbari, Venice, 1500

Is no. 7 a caravel? (Lucien Basch thinks so).



There were caravels in Venice: L. Bash refers 24 caravels armed by the Republic, with 24 men each, in 1490, and again in 1499, 30 caravels with capacities between 100 and 400 *botte*.



According to F. Lane (1963), a Venetian *botta* was the equivalent of 450 l.

Caravels? 1500, Jacopo Barbari, Venice

3. The caravels referred in the Chart of Gaia (1255) seem to be fishing vessels of which we know nothing. They would have lateral rudders...



In Portugal they appear compared to *navios*, which are masculine.

However, historian Hernani Amaral Xavier found a 1220 reference to a lady named Urraca Gil Caravela, from Alenquer, in the Nobiliário do Conde D. Pedro.

The second reference to a Portuguese caravel dates to 1255 (Foral de Gaia): *caravela sive navigio...*

It is likely that caravels were lateen rigged from the beginning: square rigged vessels were rare in the Mediterranean between the early 6th century and the mid-13th century.



Basilica di Sant'Apollinare Nuovo, Ravenna (504-526).



Church in Peč, Kosovo (c. 1250).





Malcolm Elbl mentions a 1226 reference to a Portuguese caravel taken by English ships on a return trip from Gasconne, but the ‘original’ text I could access [Françoise Michel, *Histoire du commerce et de la navigacion à de Bordeaux*] mentions “*un navire portugais, appelé le Cardinal*”.

Lateener, 12th or 13th century.



4. The caravels mentioned by the chroniclers from the mid-15th century onwards, engaged in the exploration of the Atlantic, are also unknown to us.

Alvise Cadamosto mentions eyes painted on these vessels' bows.



Caíque (1960s)
Col. Seixas, Museu de Marinha, Lisboa



Caravels must have been acknowledged as good vessels already in the early 15th century: two were built in Brussels by Portuguese shipwrights, in 1438 and 1439, for the Duke of Burgundy Philippe Le Bon.



Brussels around 1572

Un programme de constructions navales (1438-1441)

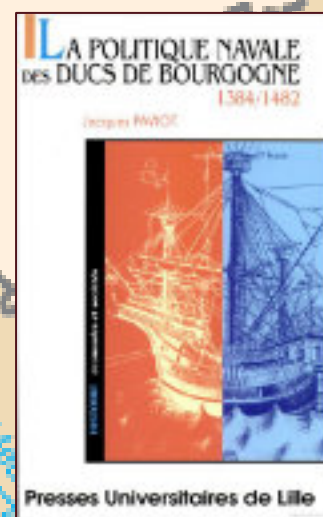
Déjà en 1436, des Portugais et des Galiciens avaient fabriqué une galée pour le duc de Bourgogne, sous la supervision d'Álvaro de Brito. Ce dernier avait quitté le service du duc en 1437, en lui laissant une nef⁴. Quelques mois plus tard, entre le 29 juin 1437 et le 1^{er} janvier 1438, arrivait de Portugal « Martin Phons » [Martim Afonso]⁵. Il amenait peut-être avec lui « Jehan Boyennes et Loys Heusson, maîtres charpentiers du pays de Portugal » qui firent « en le ville de l'Escluse un vaisseau par mer » et qui repartirent en Portugal avant le 26 août 1438⁶. Ce vaisseau était en fait une caravelle, la toute première à être fabriquée en dehors de Portugal alors que le terme faisait juste sa réapparition dans ce pays⁷. Elle fut tout de suite utilisée : avant le 26 août 1438, le duc faisait délivrer vingt-six livres huit sols « a Jehan Alphons

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JACQUES PAVIOT

[João Afonso], Portugaloiz, [...] pour armer une carvelle qu'il a nagaires faite afin de tenir seurs les pescheurs de la mer entour le Crotoy »⁸. João Afonso était un des maîtres charpentiers qui, resté au service du duc, allait bientôt construire d'autres navires. La caravelle fut peut-être utilisée par « certains compagnons qui aloient sur mer en aucuns voyaiges et lieux secréz », à qui Martim Afonso donna, de la part du duc, cent vingt livres et qui partirent entre le 1^{er} juillet et le 15 août 1438⁹, avec la charge de ramener de Portugal d'autres charpentiers et ouvriers.

En effet, le 13 août, fut ouvert, à Bruxelles, sur une rive de la Senne, le chantier de « deux carvelles par mer »¹⁰. Cette construction fut dirigée par João Afonso déjà cité¹¹. Le bois, pris dans les forêts de



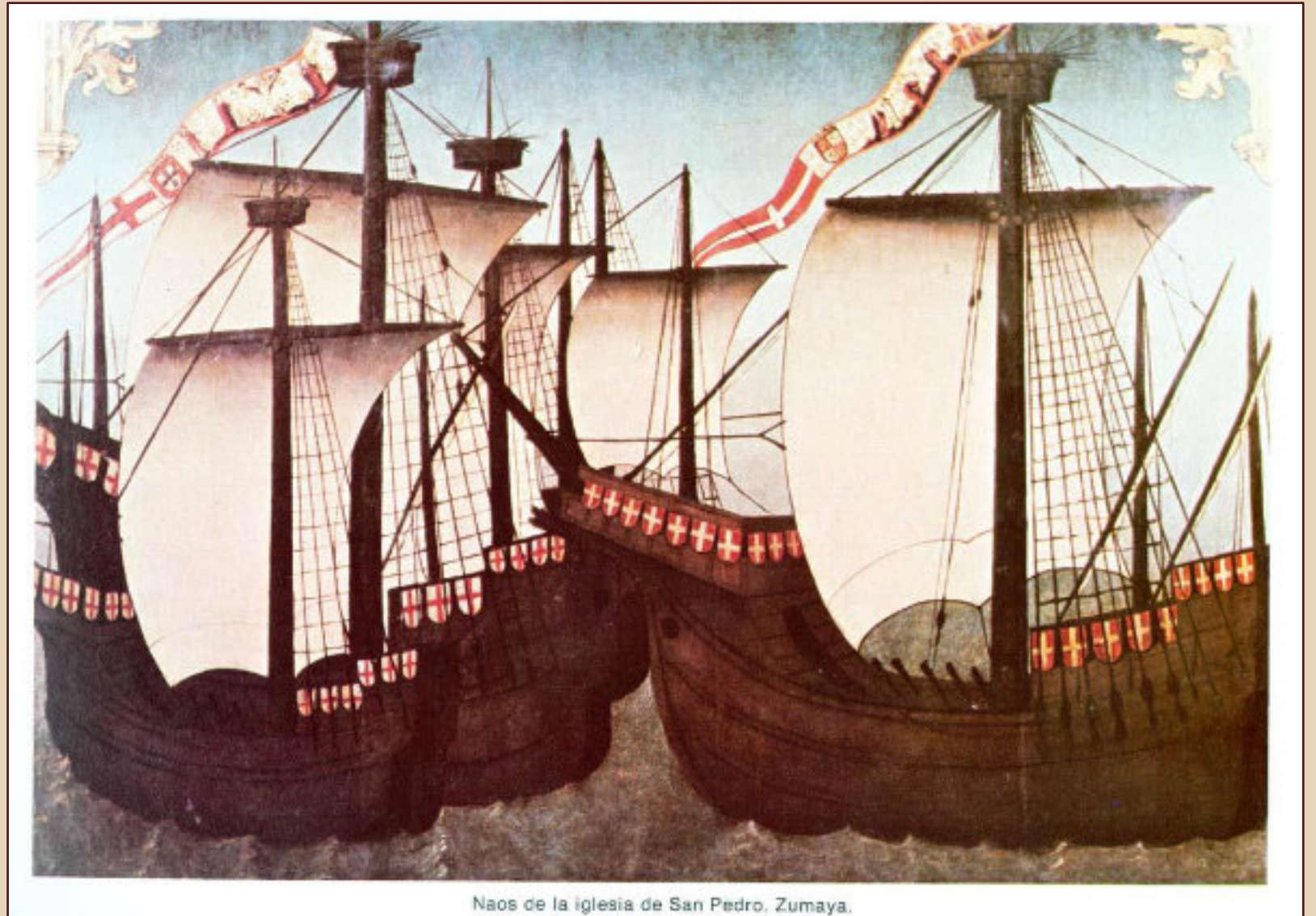


Around 1500, when we have the first images and descriptions, caravels are:

1. Small ships of 15 to 50 tons;
2. Built with flush-laid planking;
3. One, two, or three lateen-rigged masts;
4. Yards inside the shrouds;
5. Mainmast on the center of the keel;
6. Stern castle;
7. No forecastle;
8. Stern panel;
9. Central rudder;
10. LTBR between 3.8 to 4.1?

Some of the features that characterize caravels around 1500 may have been fairly recent innovations:

1. Stern panels appear in the iconographical record after 1475;



Some of the features that characterize caravels around 1500 may have been fairly recent innovations:

2. Central rudders appear on cogs, in the 12th century, and seem to be characteristic of square-rigged ships in the 15th century.

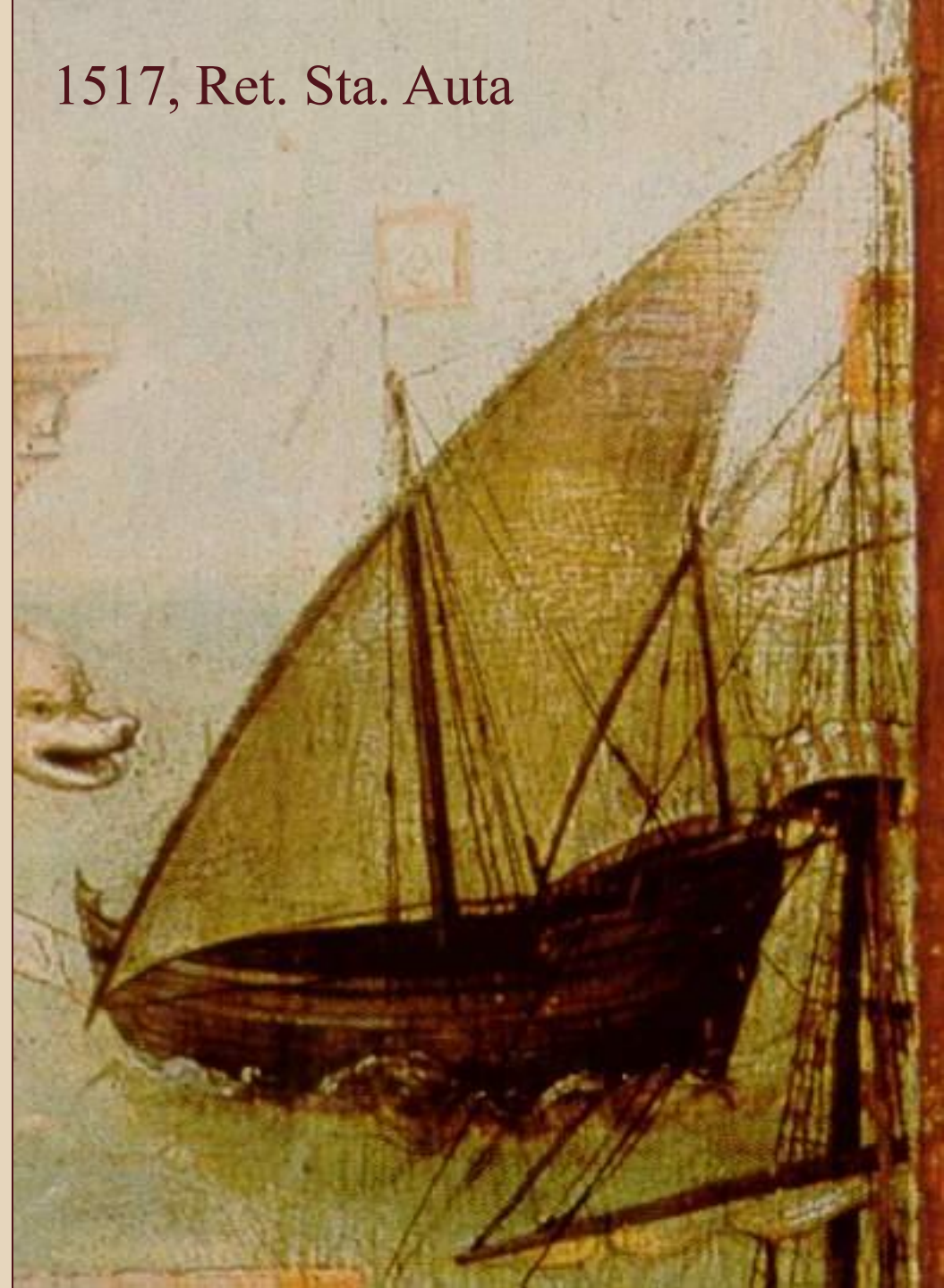


Leiden View of Lisbon (1530s?)

After 1500 we have:

1. Manoel Fernandez 1616 *regimentos*;
2. Lists of timbers from the 1590s *Livro náutico*;
3. A (small) number of images;
4. A (small) collection of dimensions and proportions;
5. A few details and scantlings from 16th century shipwrecks of compatible sizes, excavated by archaeologists and published.

1517, Ret. Sta. Auta



This information refers to several different types of vessels, all referred to as caravels:

1. *Caravelas latinas* (15-16th centuries)
2. *Caravelas redondas* (15-16th century)
3. *Caravelas de Alfama* (16th century)
4. *Caravelas de armada* (16th century)
5. *Caravelões* (16th century)



1. Caravelas Latinas

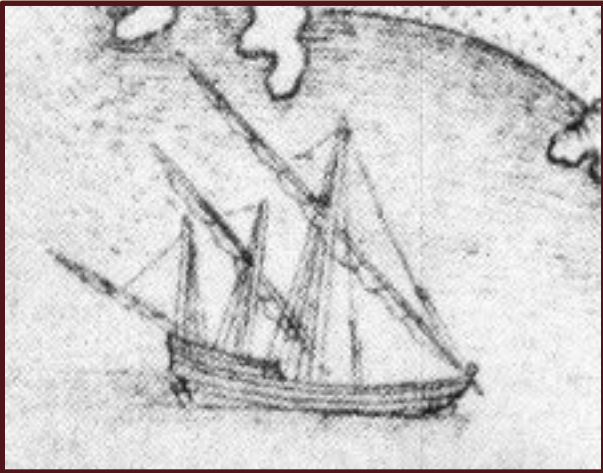
During the 14th century they are not mentioned in Portuguese documents. In the mid-15th century caravels appear as *lateeners* with a capacity around 50 *tonéis* and crews between 20 and 25 men.



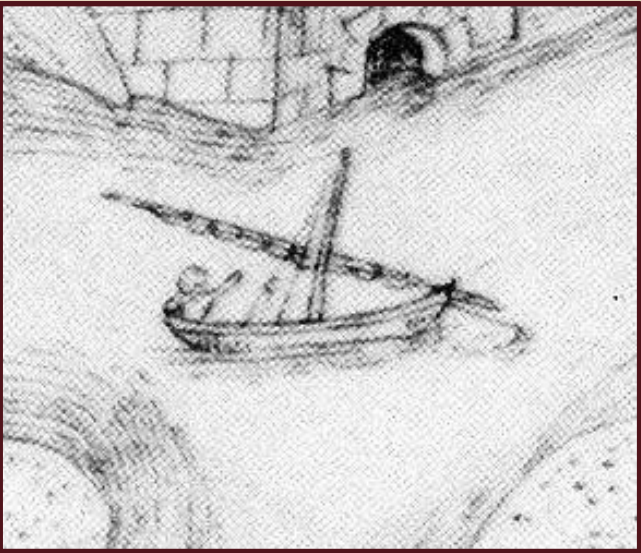
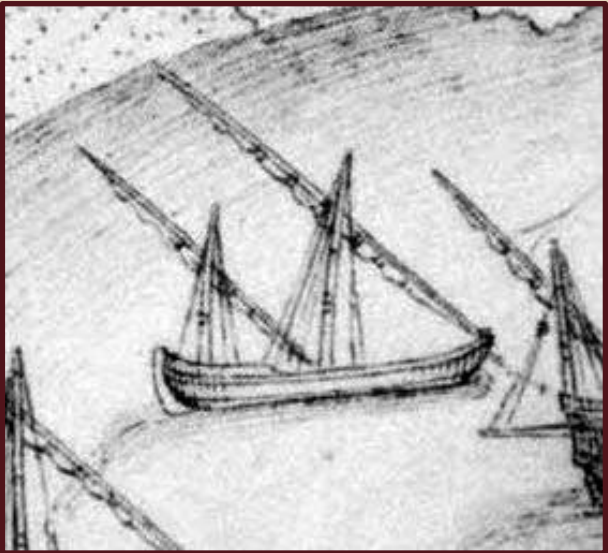
Caravel, Valença do Minho, 1509.

It looks like small caravels with 2 or 3 masts with lateen sails, endured over one century without much change.

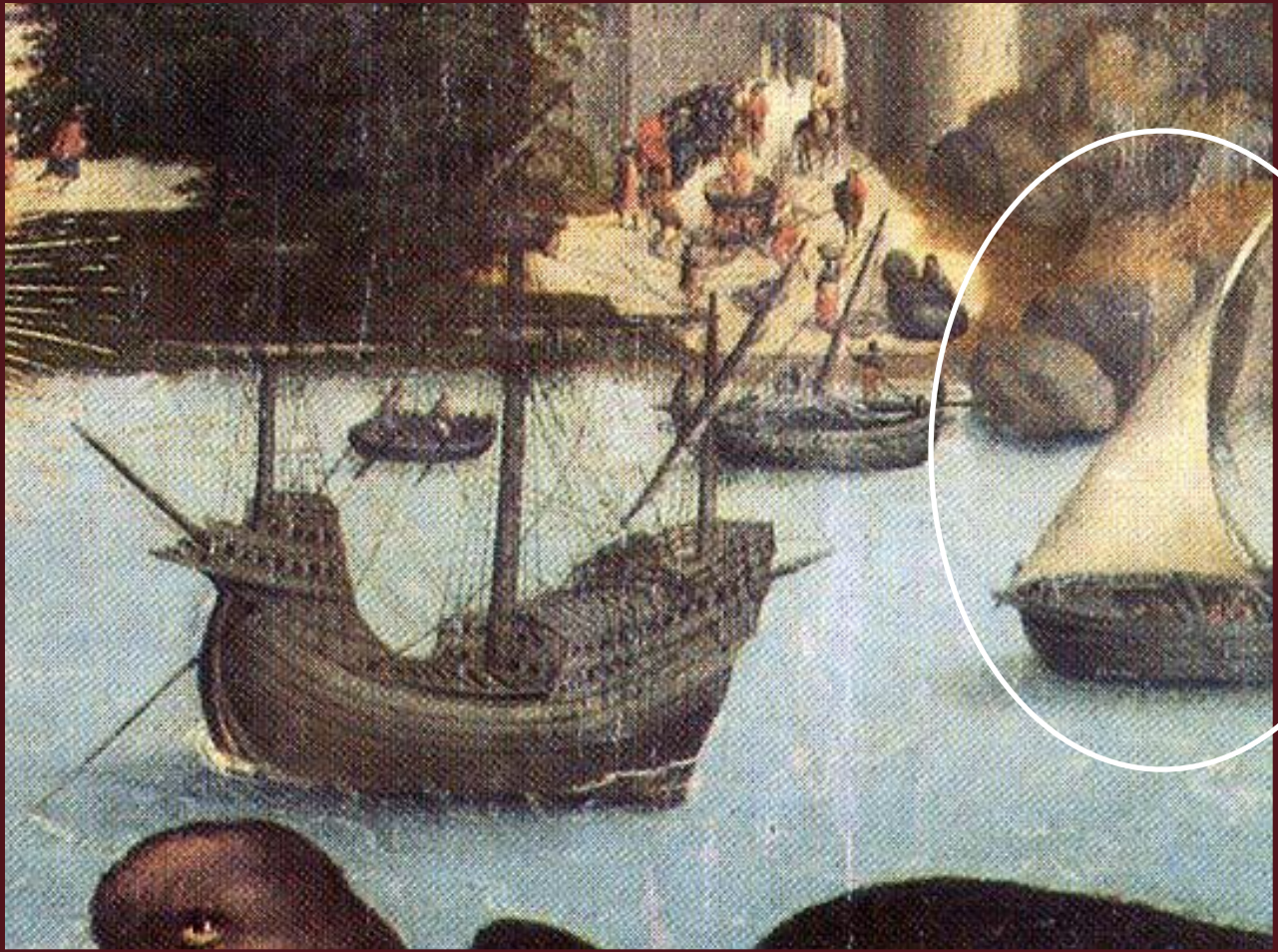
Caravels?



Other lateeners:



But we don't know what characteristics defined a caravel, or what separated a caravel from the other lateeners of their time.

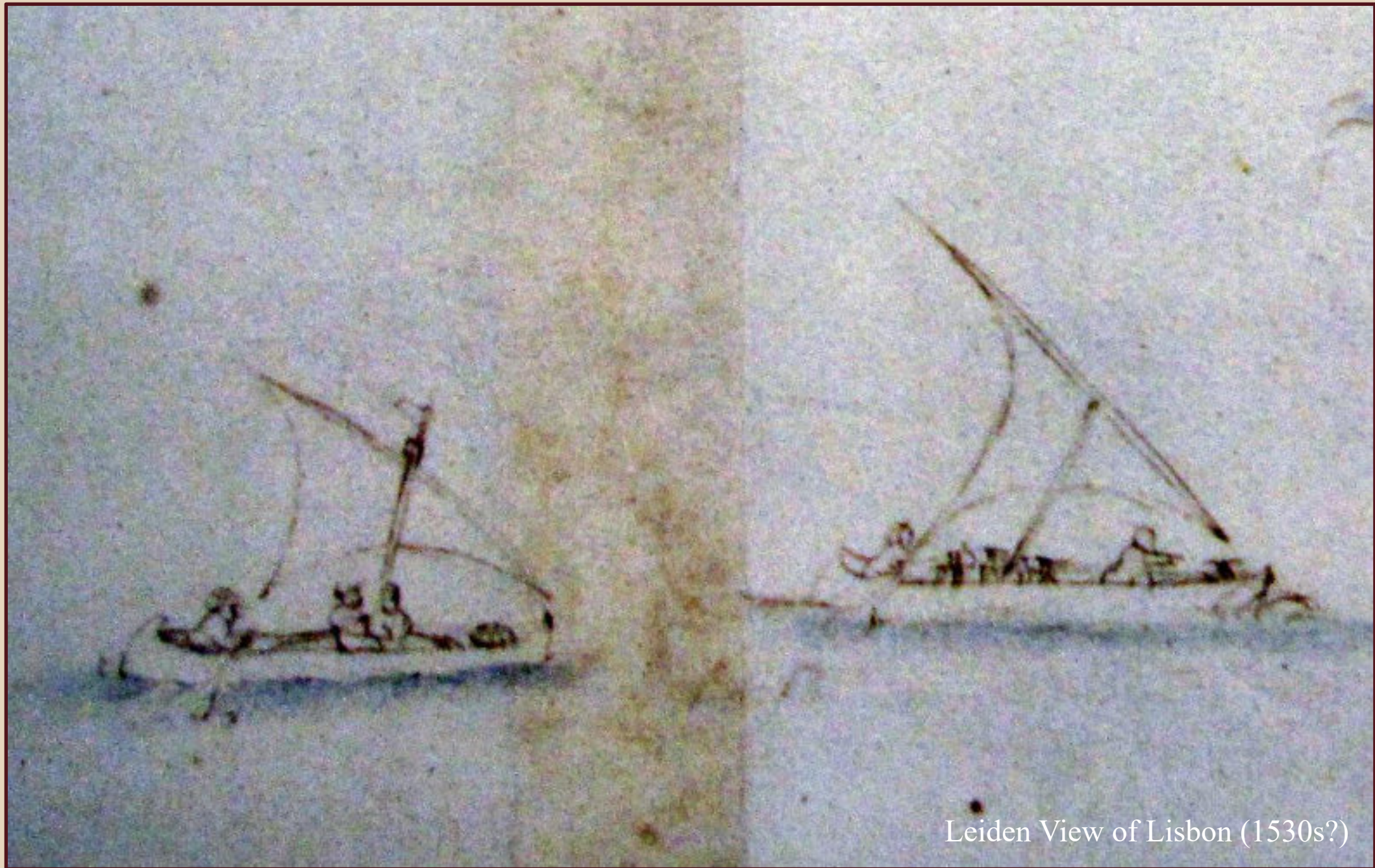


S. João de Patmos, 1475?



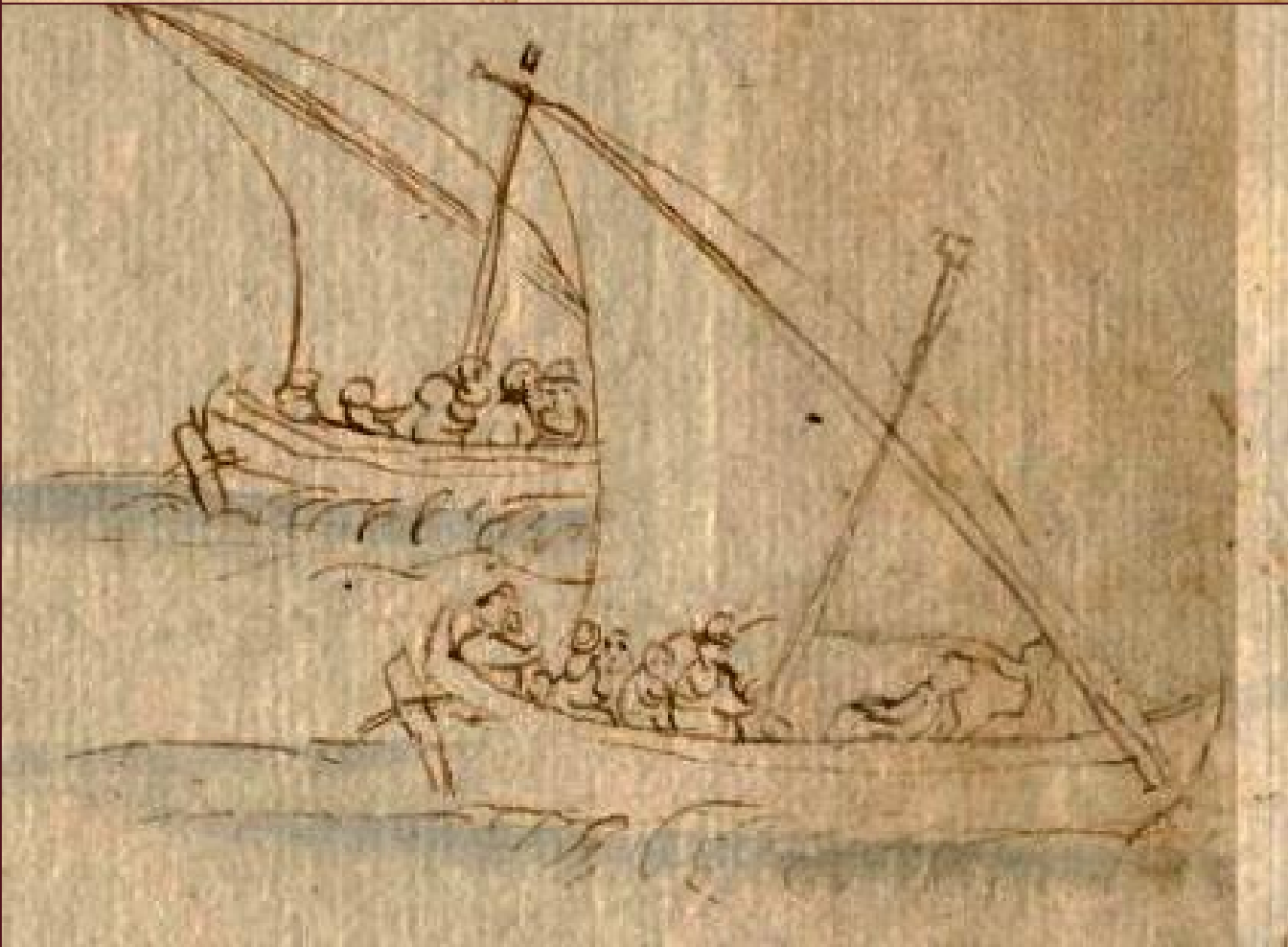
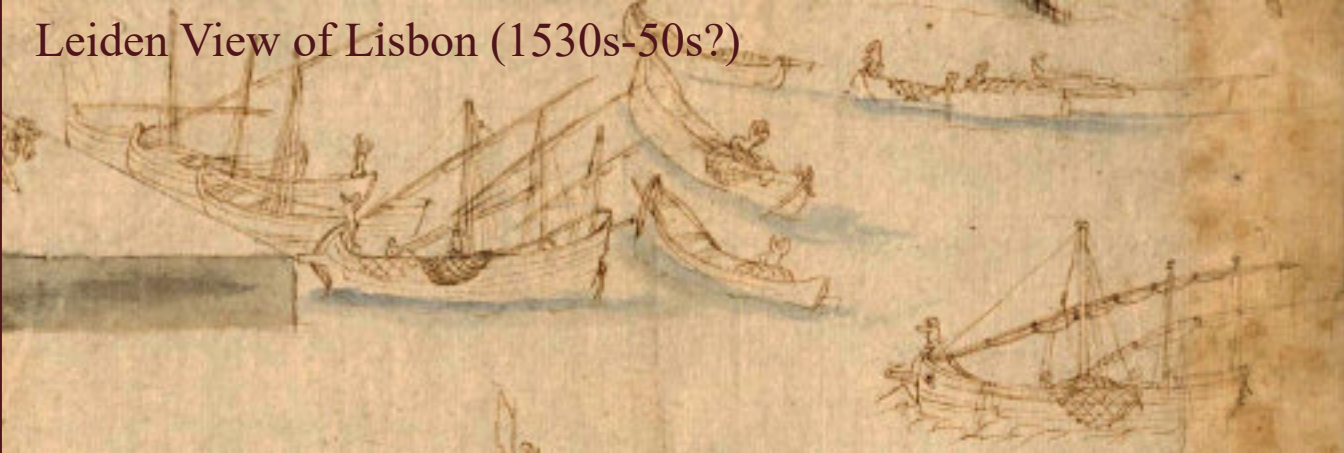
Retábulo de Sta. Aute, c. 1517





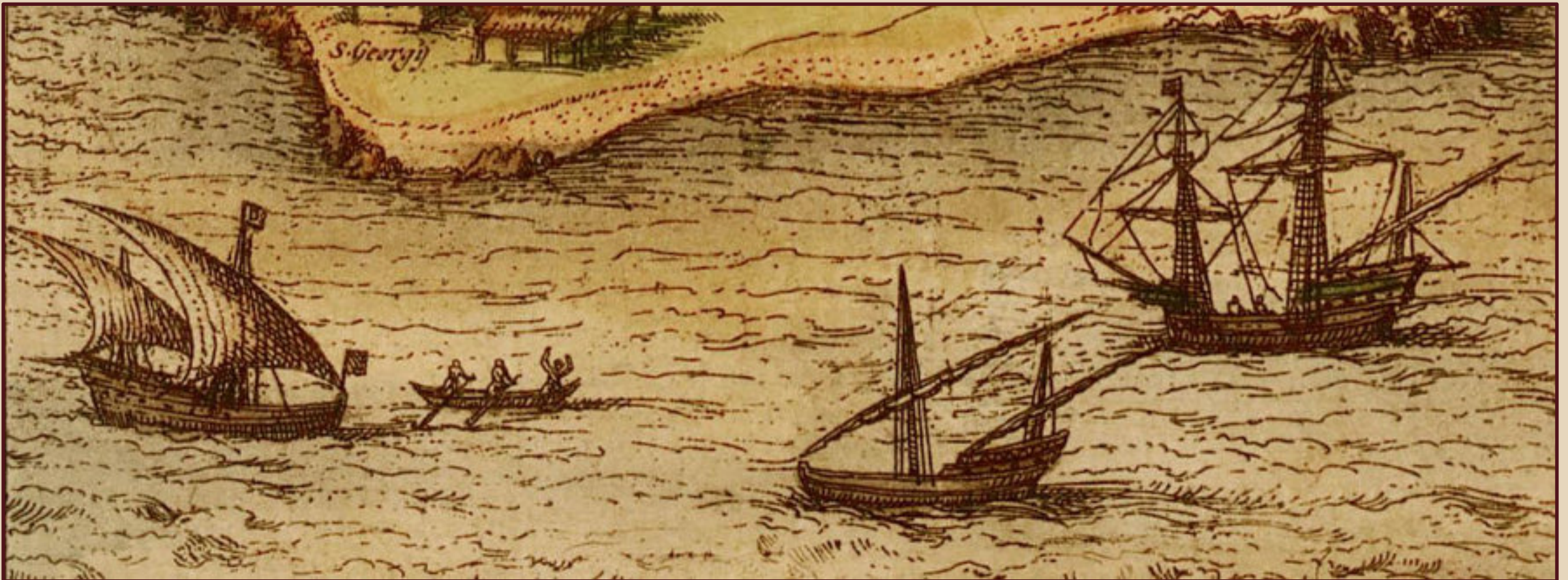
Leiden View of Lisbon (1530s?)

Leiden View of Lisbon (1530s-50s?)



In the 15th century caravels are small. Quirino da Fonseca claims that, according to Braancamp Freire, 54 *caravelas* leaving Lisbon in 1488 e 1489 had capacities between 15 e 50 *tonéis*.

S. Jorge da Mina, 1572 (Braun and Hogenberg)



In 1571 D. Jerónimo Osório, in *A vida e feitos de el-rei D. Manuel*, still describes rather small vessels:

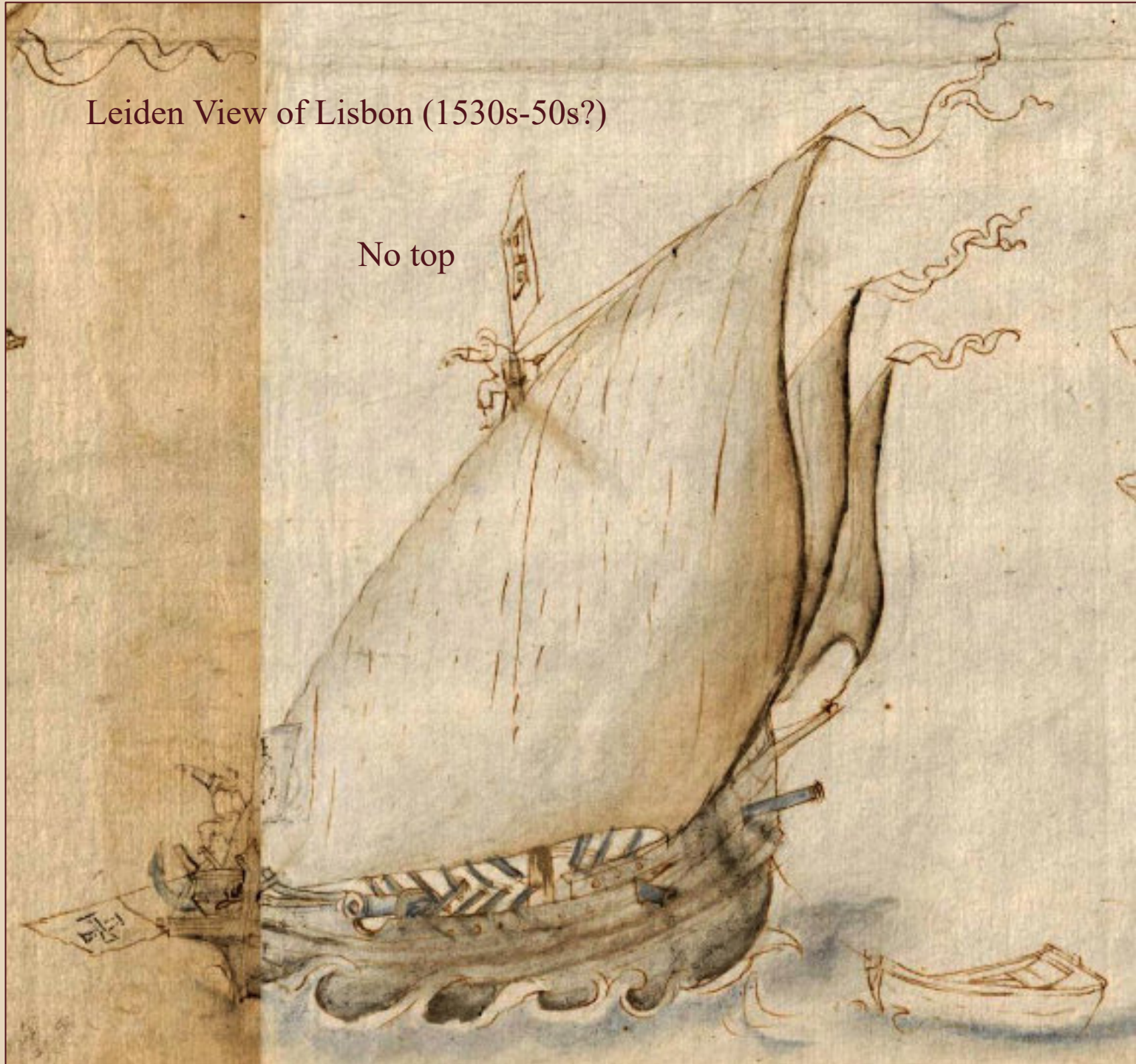
These caravels don't have tops (cestos de gávea), nor their yards make right angles with their masts, but hang, inclined, secured under the masthead, and the base of the sail is triangular and almost touches the bulwarks. The yards, which are fastened to the ship's bulwarks, are as thick as topmats in their lower part and have smaller sections upwards.



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Leiden View of Lisbon (1530s-50s?)

No top



Are these two- and three-masted lateeners exclusively Portuguese?



Caravel from Piri Reis Map, dated to 1513.

José Luis Casado Soto found references to 125 caravels in the *Registro General del Sello* in the *Archivo General de Simancas* between 1476 and 1496:

12% of the caravels from the Mediterranean.

45% from Andalusia;

19% from Portugal;

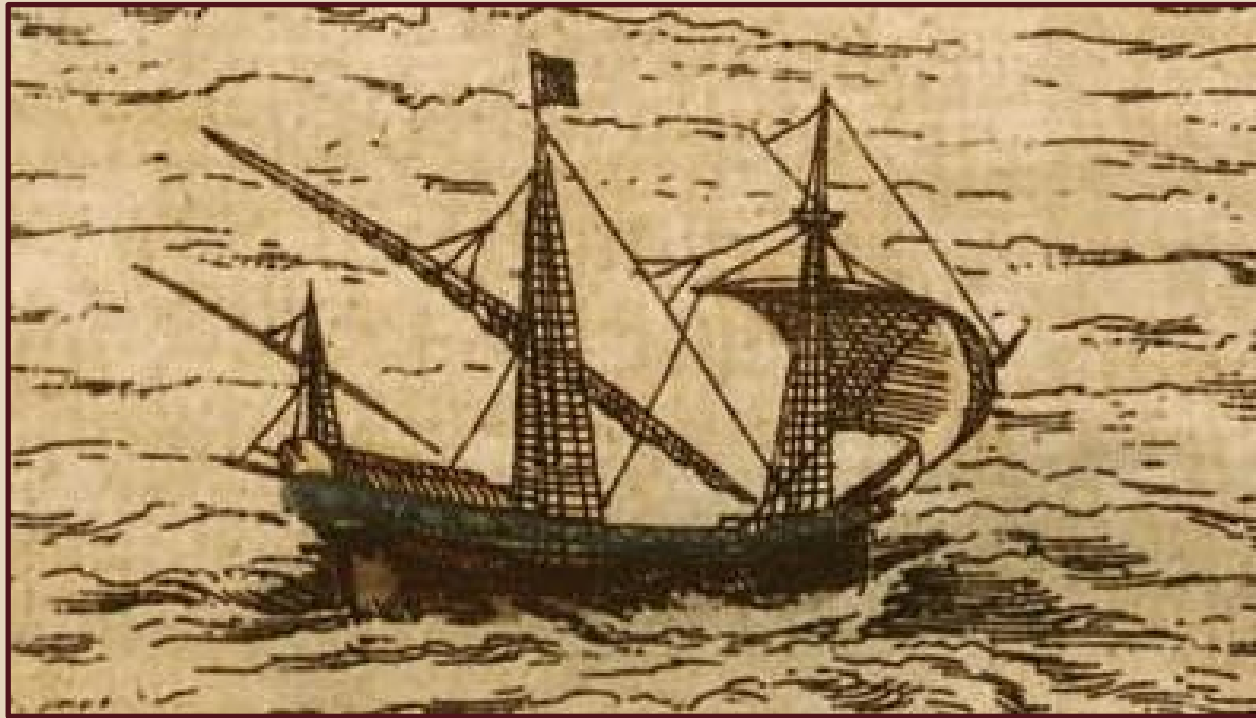
21% from the Cantabrian region; and

3% from France, England and the North Sea;

There are no mentions to any possible differences between them.

Were Cantabrian and Andalucian caravels much different from the Portuguese ones?

Foremast is stepped far forward.



Santander, 1572 (Braun and Hogenberg)

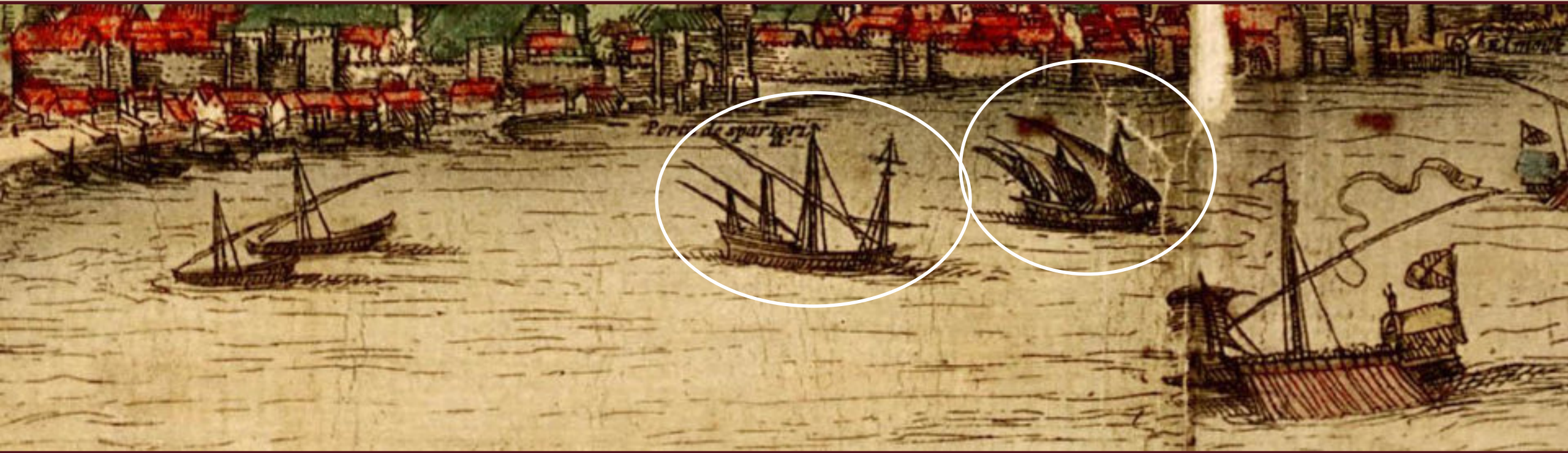


Venice, 1572 (Braun and Hogenberg)

Were Cantabrian and Andalucian caravels much different from the Portuguese ones?

Foremast is stepped far forward AND rakes characteristically forward.

Malaga, 1572 (Braun and Hogenberg)



2. Caravelas Redondas

Navarrete calls *caravelas redondas* “*castellanas*”.

Quirino cites him: “caravels were divided into Portuguese and Castilian, the first exclusively lateen-rigged, could sail “*cinco ou seis quartas (55° to 65°)* into the wind, facilitating the Portuguese routes to the African gold mines. Castilian caravels used in their seas with square sails, or better, with a square sail on the foremast.”

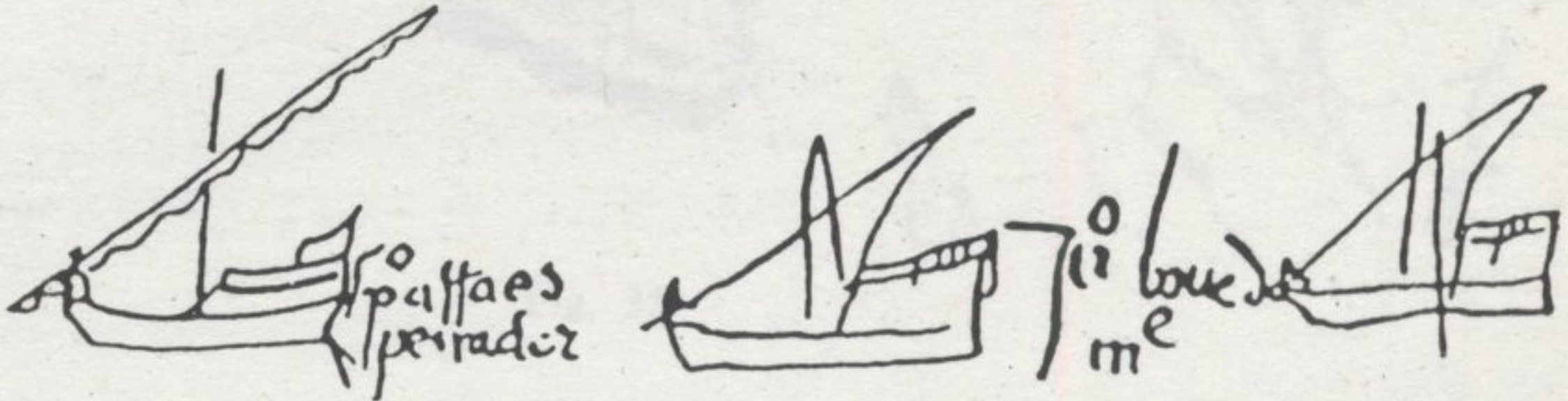


Santander, 1572 (Braun and Hogenberg)

Quirino refers also a 1512 letter from D. Fernando to Pedrarias Davilla, in Panama: “*Yo vos mando que ... se hagan luego tres o cuatro carabelas, al modo de Andalucía, las dos, e las otras dos, pequeñas, latinas, como las de Portugal...*”

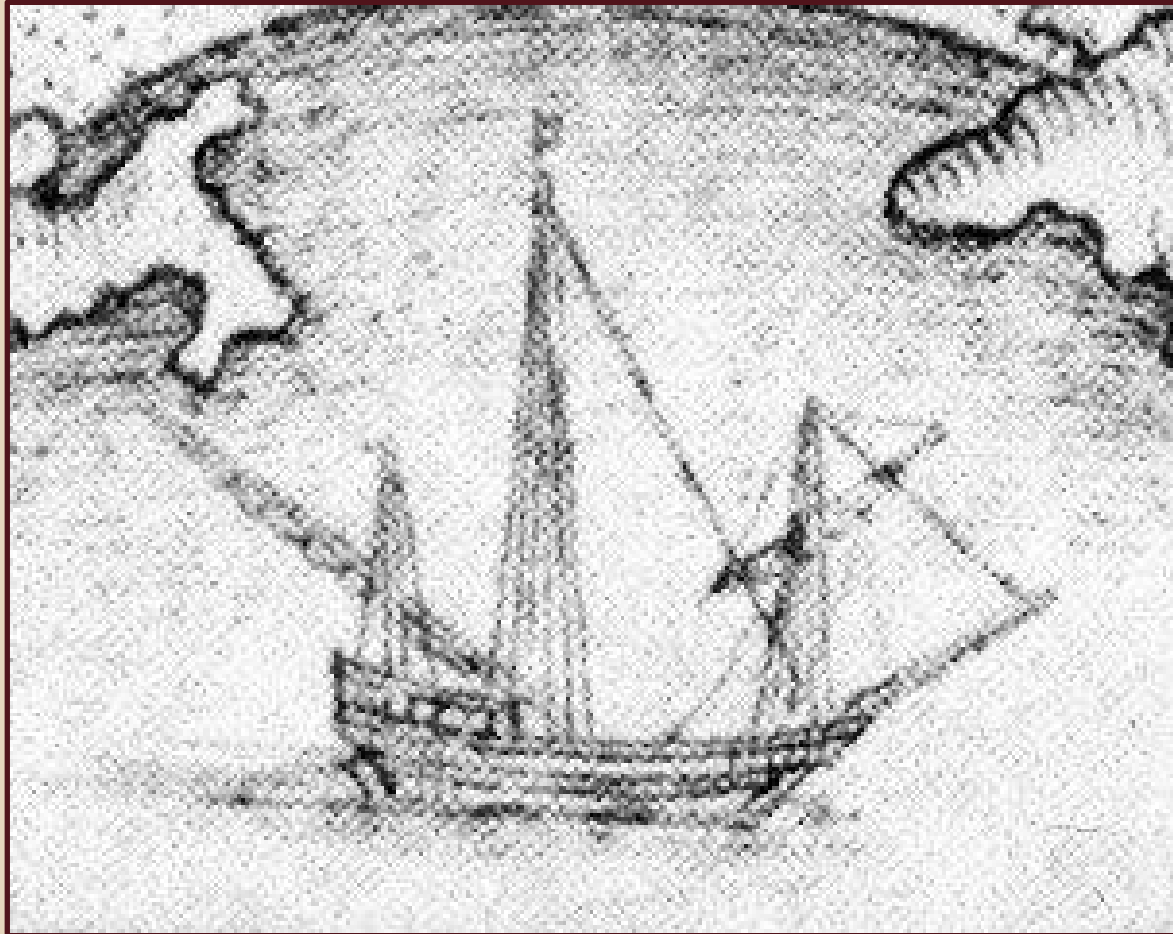
But small caravels also appear in Spain, in the late 15th century.

Late 15th century fishermen signatures from Puerto de Sta. Maria, Spain.

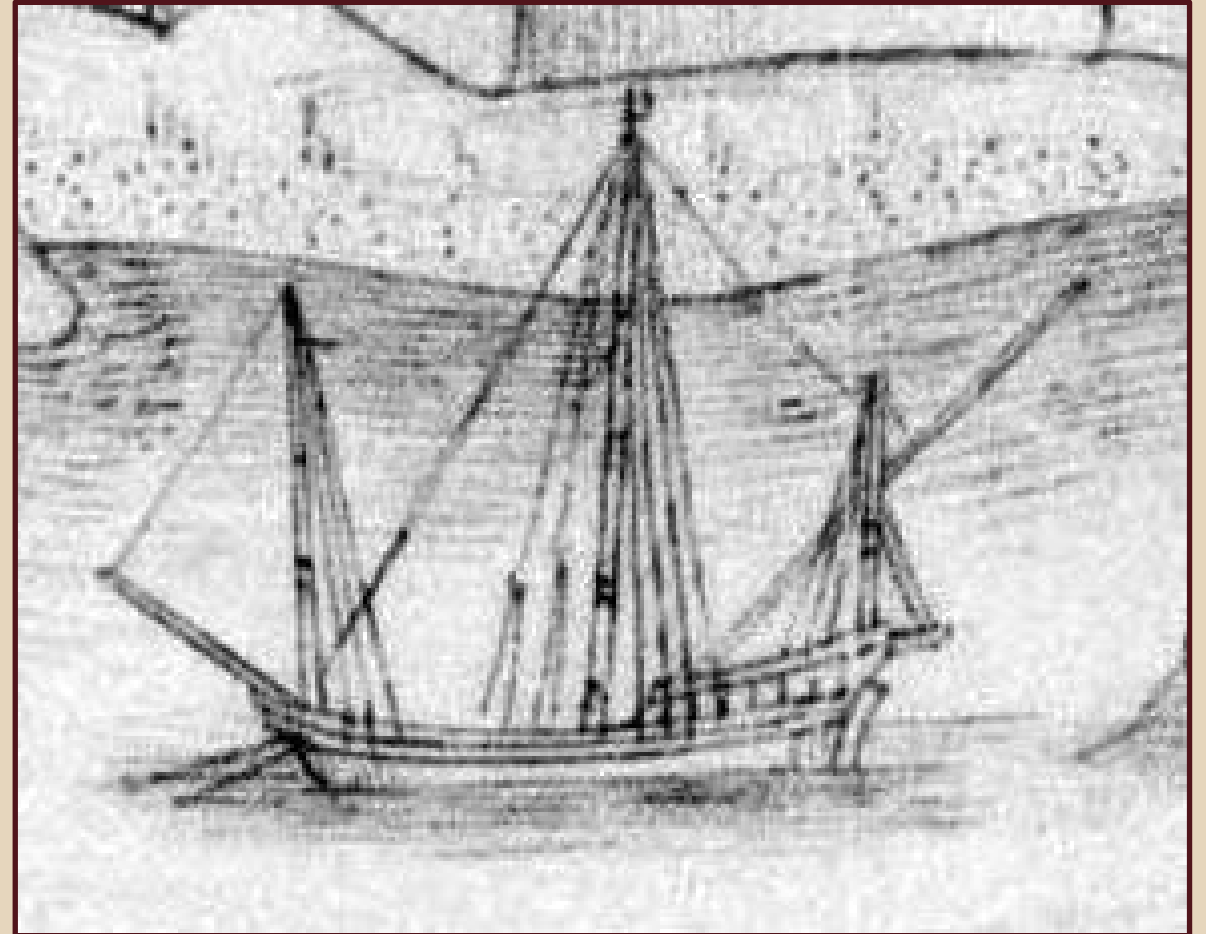


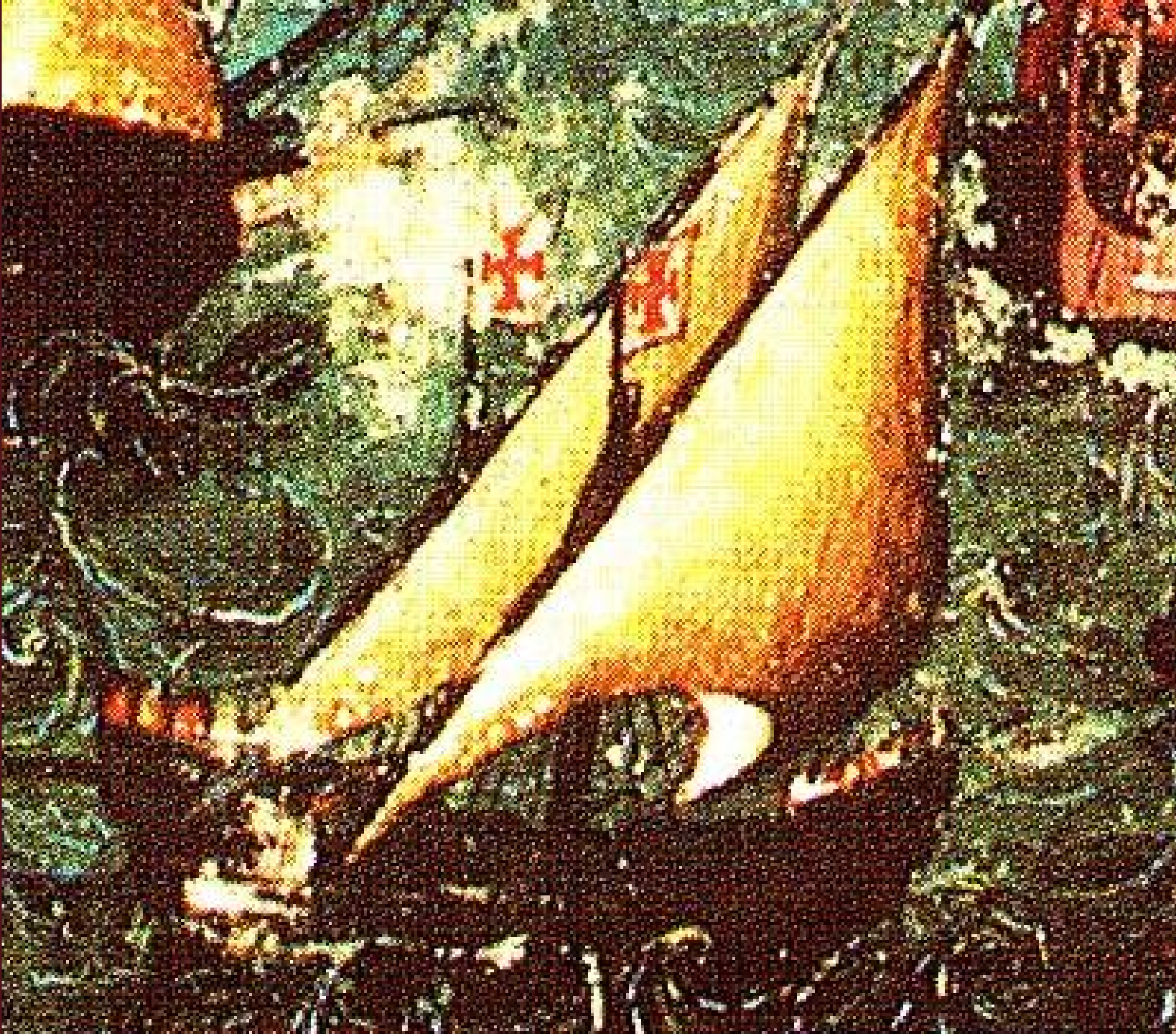
And 3-masted *caravelas redondas* appear in Portugal, already in 1502 (voyage of Vasco da Gama) and 1509:

Duarte d'Armas, Mértola, 1509.



Duarte d'Armas, Valença do Minho, 1509.





3. Caravelas de Alfama

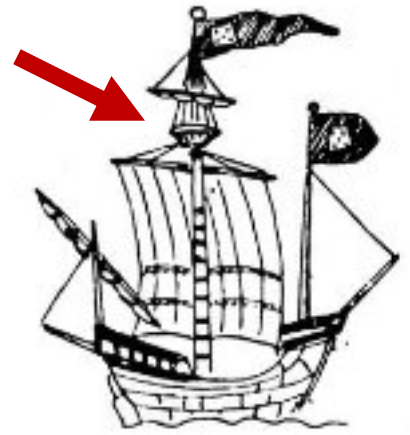
Paulo Monteiro found this reference in a Spanish late 16th century document: “(...) *Tambien se quedan despalmado dos caravelas pequenas destas que aqui llaman de Alfama que las pide el Almirante para llevar consigo...*”

Were at least some of the Spanish caravels larger?

José Luis Casado Soto mentions a witness account of Columbus' **second** voyage ships.

The witness, Pedro Mártir de Anglería claims that Columbus took 17 vessels: 3 large cargo ships with tops, 12 caravels, and 2 large caravels, *with masts large enough to support tops.*

Nothing is said about their rigging.



Was their rigging always different from that of the Portuguese caravels? Two documents dated to 1498 (before Columbus' 3rd voyage) contain the inventories of the rigging of two caravels:

- a) *Santa Clara*, or *Niña* (60 toneles – probably not the *Niña* of the first voyage), and
- b) *Santa Cruz*, or *India*, built in Hispaniola during the second voyage with the remains of the ships lost in a hurricane.



Both these caravels had four masts, and both had square sails on the fore and main masts, and lateen sails on the mizzen and bonaventure.

a) *Santa Cruz* has a bowsprit and a spritsail; and

b) *Santa Clara* has “*dos botalos vno del trinquete y otro de la cont[ra]*”.

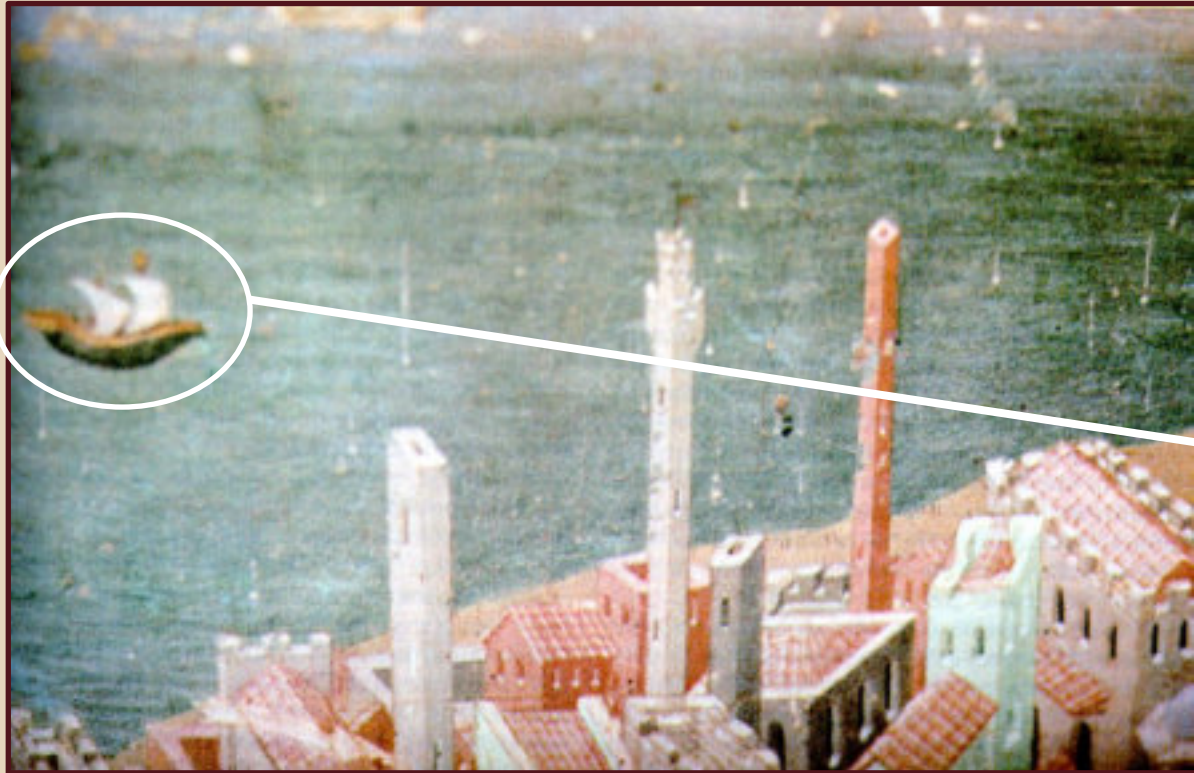


¶ Diogo fîç correa D
por feitor de corfim.

Square-lateen rigging

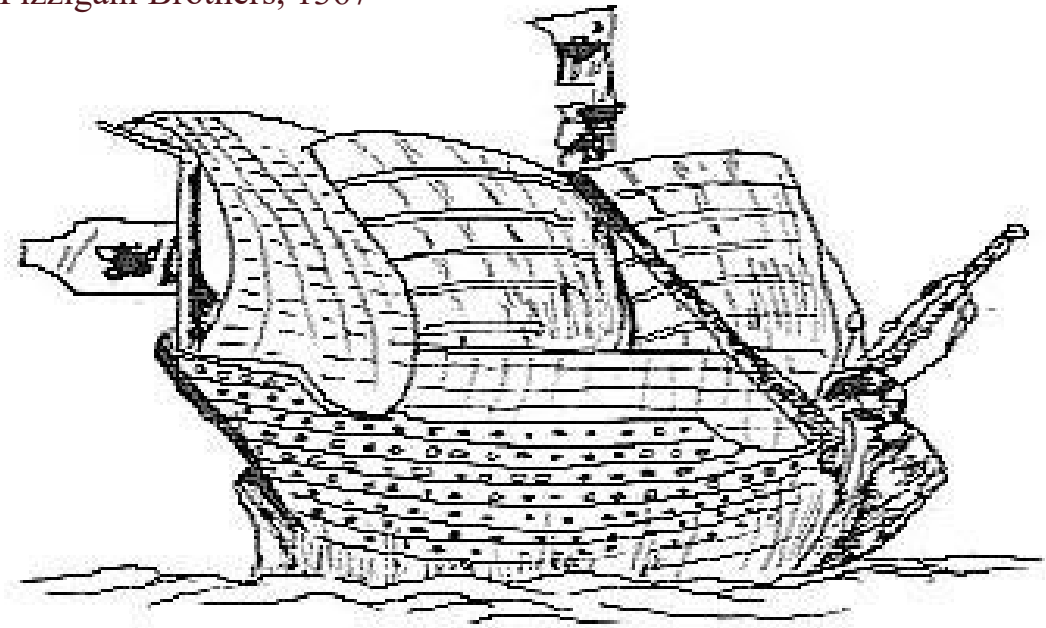
Combining square and lateen sails on a ship is a well-known practice in the Mediterranean since the early 14th century.

Ambrogio Lorenzetti, 1336-38.

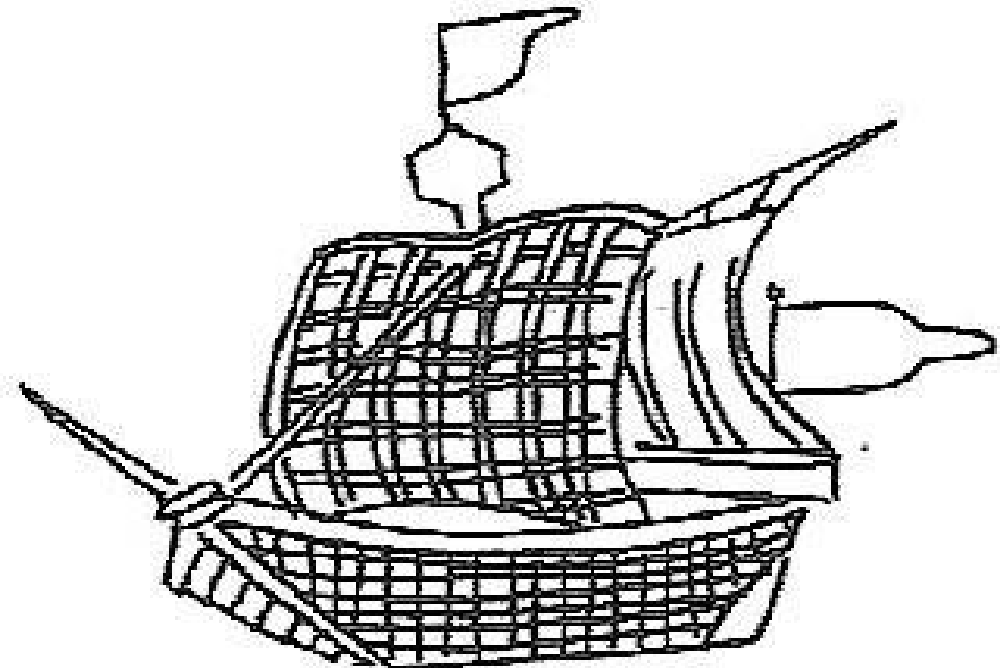


From the 1330s onwards it was common to rig 2-masted ships with a square sail on the foremast and a lateen sail on the main mast (is *mezzo masto* the root of mizzen mast?).

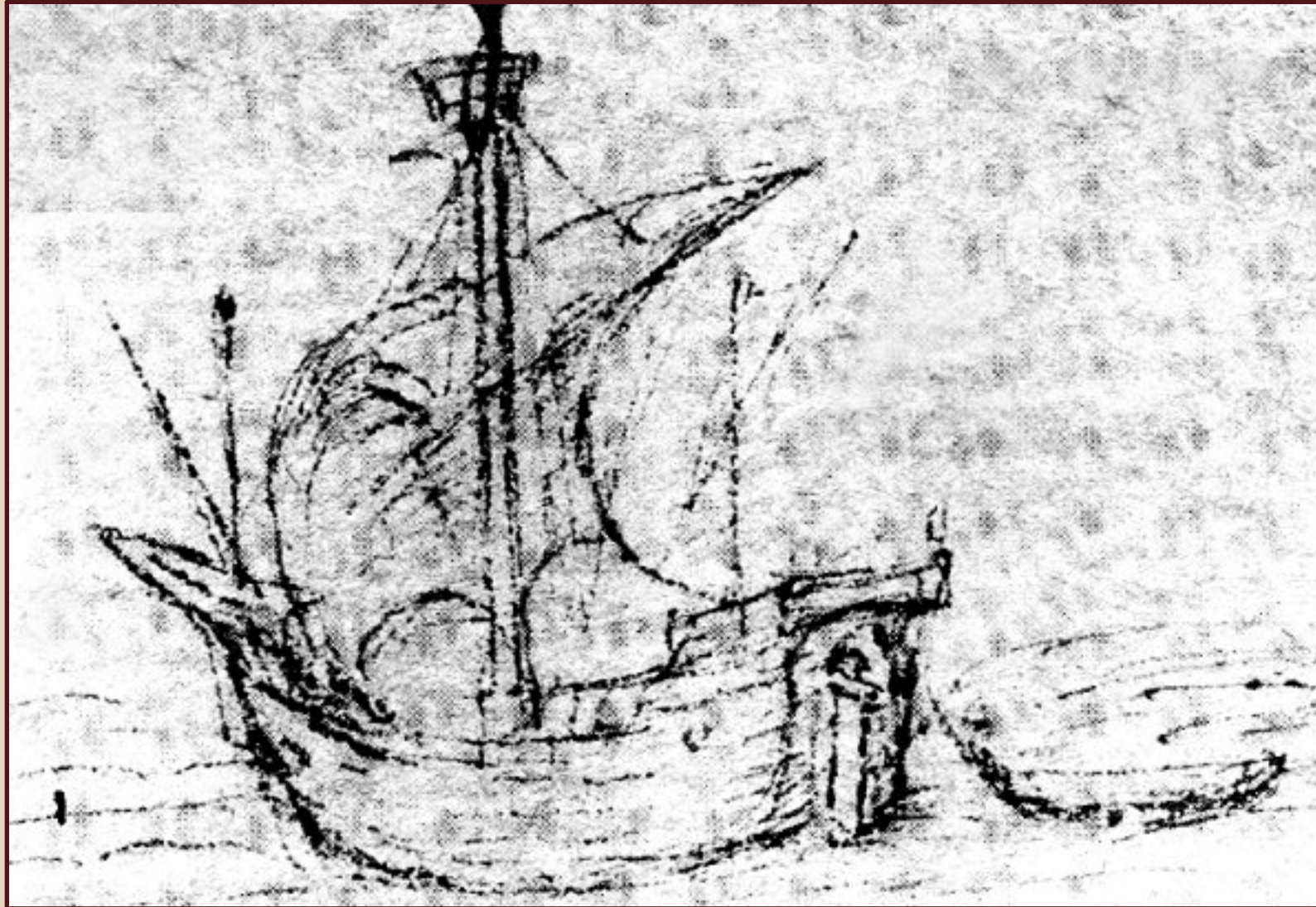




Columbus re-rigging of his caravels was a normal practice in the 15th century. The choice of the rigging depended on the prevailing winds for each route.



As a third mast appears in the iconography – in Catalonia, in 1409 – a combination of square and lateen sails becomes the norm on oceangoing navigations.



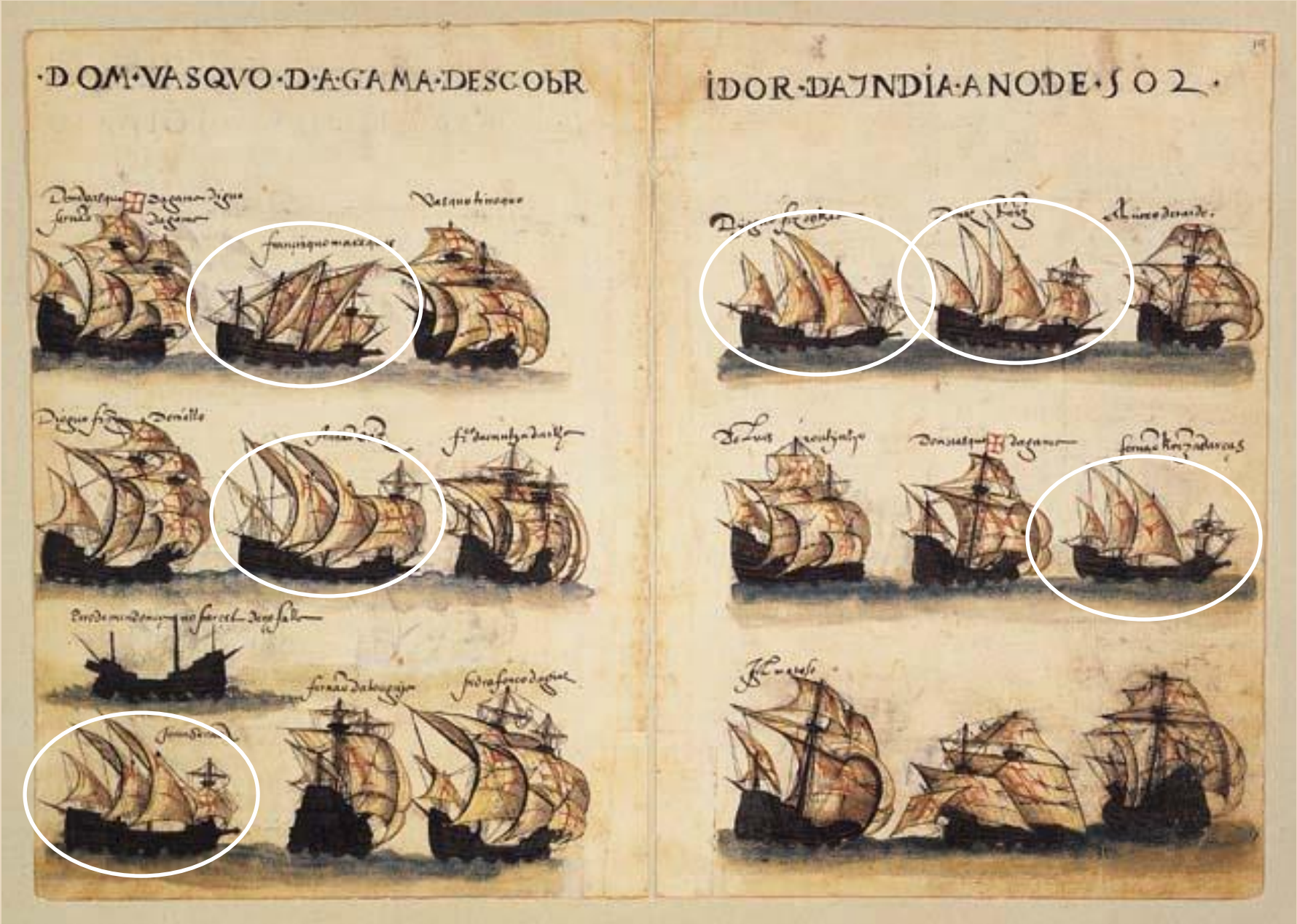
11th century representation of a 3-masted Arab ship.

Gaspar Correia says that Vasco da Gama sailed to India in 1502 with “*cinco caravelas latinas, que mandou muito bem concertar*” and “*iam com velas redondas armadas, para com elas navegarem quando cumprisse*”. He does not mention how many masts these ships had, and the representations we have date to around 1565...



Memória das Armadas (3)

...and Lisuarte de Abreu (6):



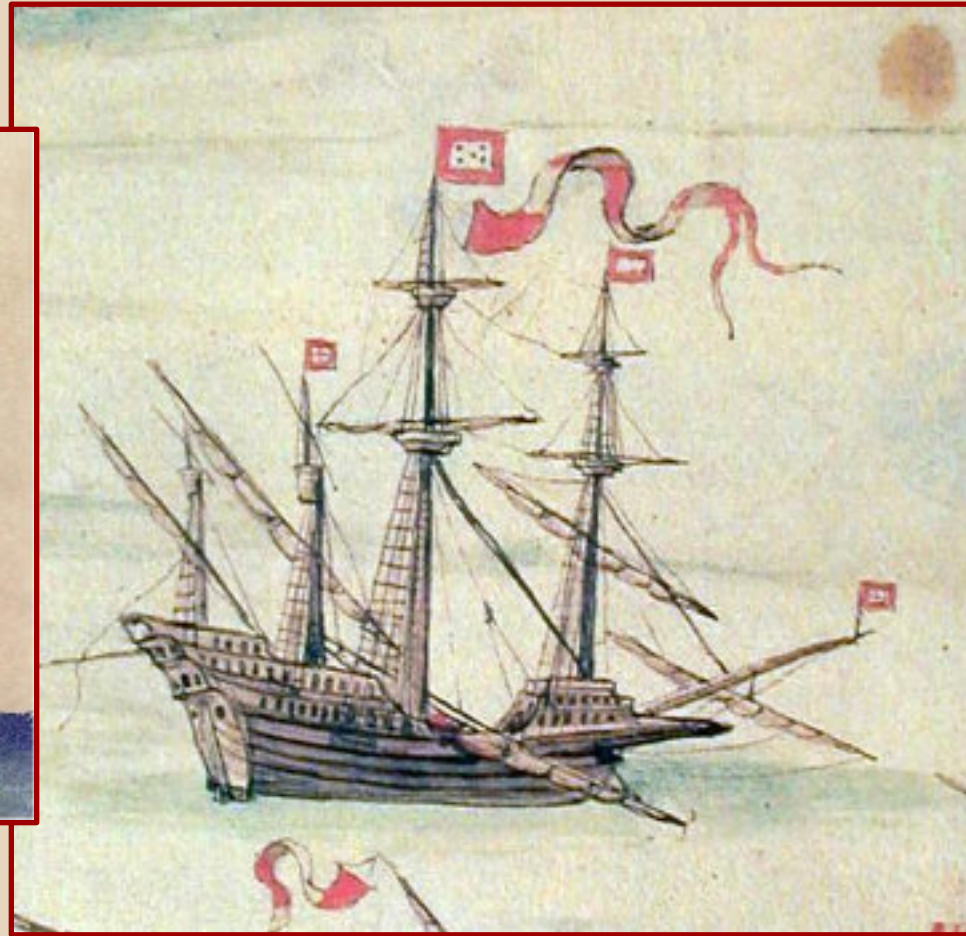
When a fourth mast appears, in the late 15th century, square sails are always present, either on the fore and main masts, or only on the foremast.





Large cargo ships – *naus or naos*, *caracche*, or *hulks* – as they were known in the Atlantic, Mediterranean and Baltic, tend to have three masts and square sails on the bowsprit, fore and main masts, and a lateen sail on the mizzen mast.

The first type of rigging, with an extra mast, is common on larger vessels such as galleons.



Or on the Spanish *caravelas redondas*, such as the *Santa Clara* and the *Santa Cruz*.



Sta. Clara, Columbus Foundation.

4. Caravelas de armada

The second rigging arrangement is typical of the Portuguese *caravelas de armada*.



It is curious to notice that in the 1550s Fernando Oliveira is skeptical about the qualities of the *caravelas* de armada. In his *Arte da guerra no mar* he states:

“A mim me pareceu sempre, que caravelas de armada, não eram tão boas como são gabadas, por serem um género de navios misturado e neutro, e as partes que tomam de cada um dos outros géneros serem as piores”

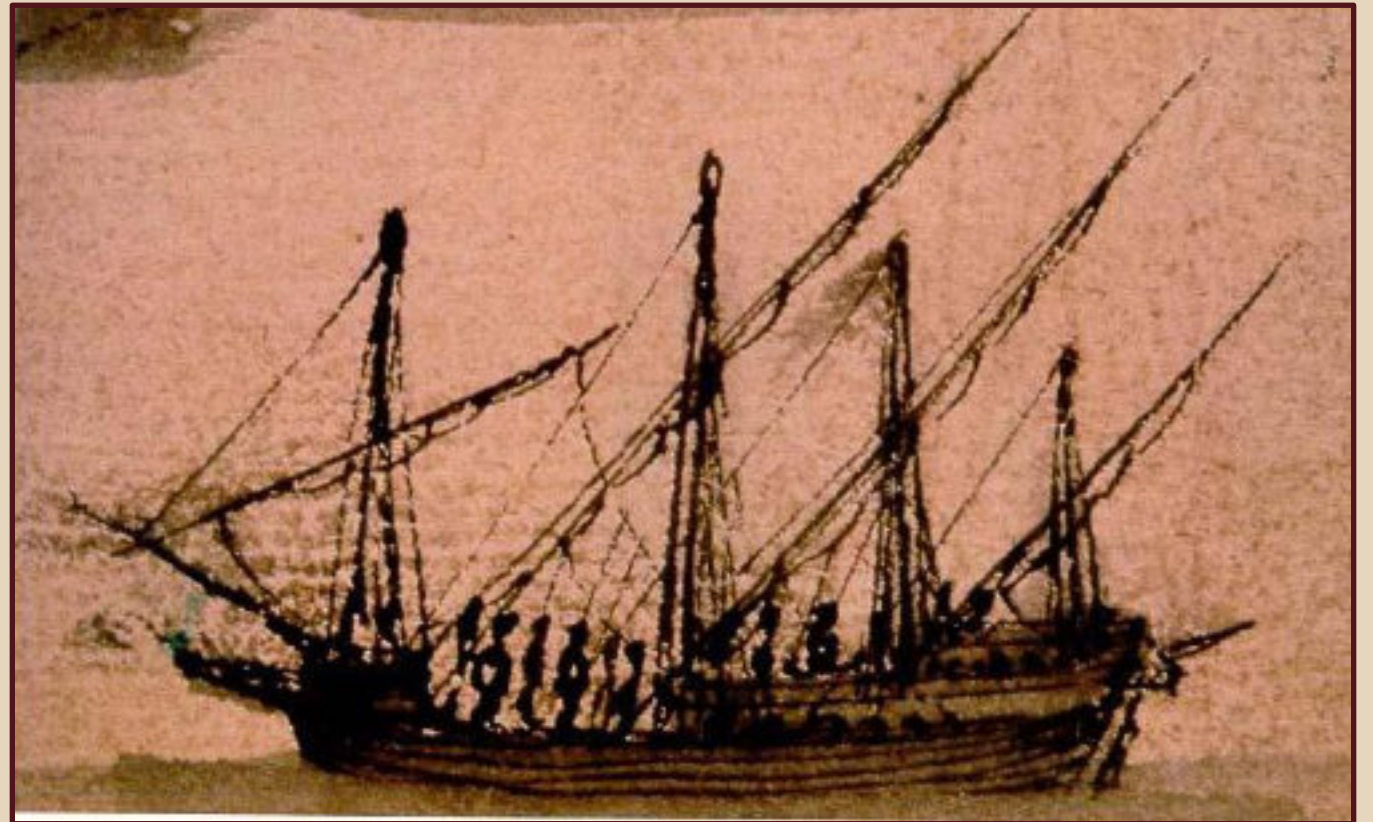


Roteiro de D. João de Castro, 1538

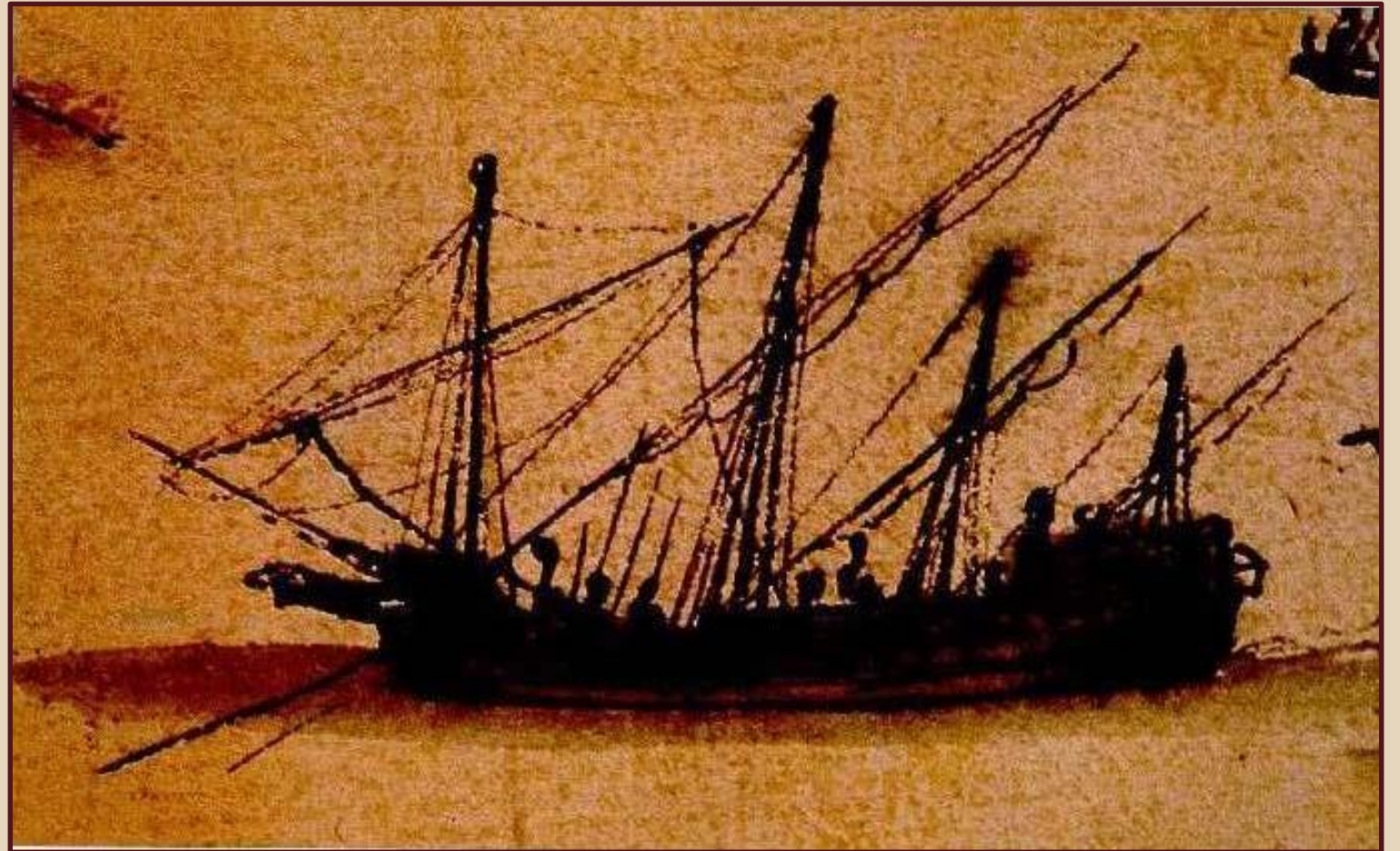
Later, in his *Livro da fábrica das naus*, Oliveira states:

“Aqui me lembra e quero o dizer, antes que me esqueça, que nunca me pareceu bem, fazer da caravela navio redondo, diga cada um o que quiser, que tudo será afeiçoado”
and *“porque, mudando-se a forma da vela, cumpre mudar-se a fábrica do fundo, a qual já não pode ser mudada”*

Gaspar Correia,
Lendas da Índia, c.
1563



In the middle of the 16th century these caravels were purposely built with a forecastle and four masts, rigged with square sails on the foremast, and lateen on the remaining three. A bit later these ships would be as large as 180 *tonéis*.

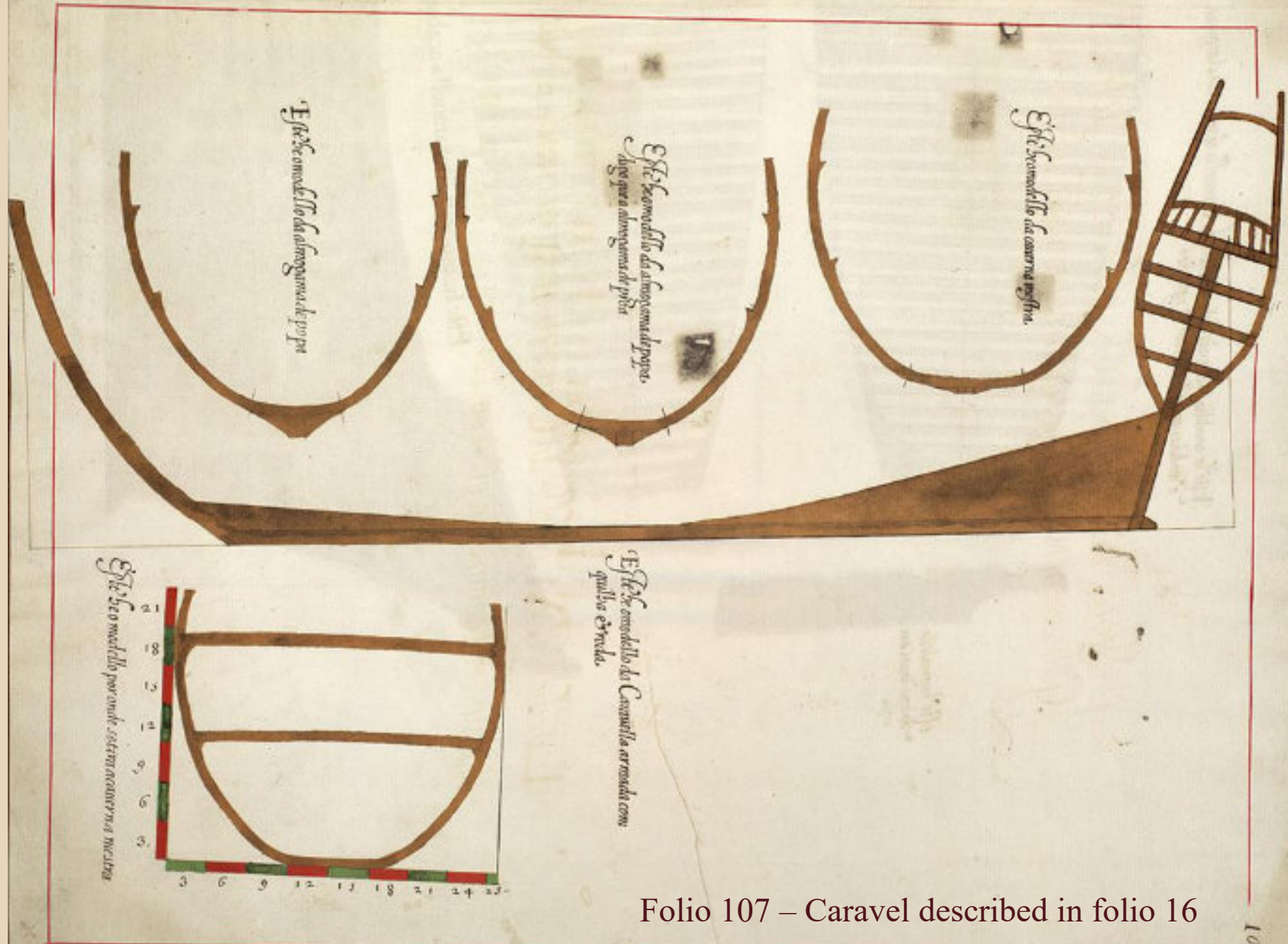




There are two *regimentos* for the construction of these caravels.



Fernandez treatise
(1616): caravels have
two decks.



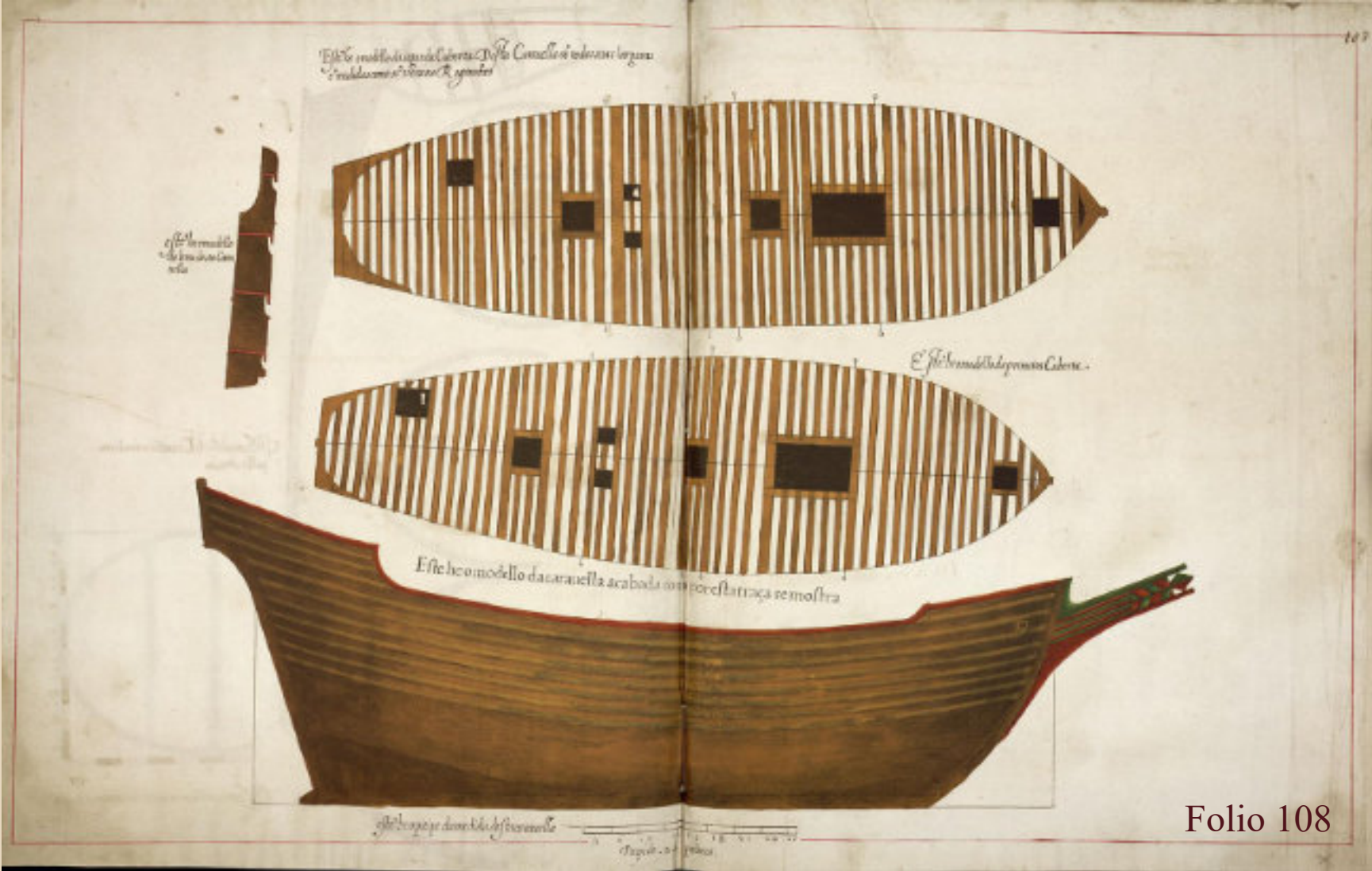
Folio 107 – Caravel described in folio 16

Folio 16: The caravel with 11 *rumos* (17 m) of keel has 23.2 m of length overall, a max beam of 6.42 m, a depth of hold of 4.1 m, and a flat amidships of 2.05 m.



Folio 108

Folio 24: The caravel with 12 *rumos* (18.5 m) of keel, has 25.5 m of length overall, a max beam of 7.19 m, a depth oh hold 4.40 m, and a flat amidships of 2.31 m.



Folio 108

José Luis Casado Soto has wrote a seminal paper about the size of Columbus' ships.

Their 1492 tonnages are known:

a) around 110 *toneles* for the small nao *Santa Maria* (crew of 40);

b) 55-60 for *Pinta* (crew of 30); and

c) 40-50 for *Niña* (crew of 20), both caravels.



Jose Luis indicates the average ratio between length on deck (*eslora*) and the beam (*manga*) during the first half of the 16th century as:

Naos cantábricas → $E/M = 3.1$

Carabelas → $E/M = 3.35-3.5$

For the same period, the depth in hold was $M/2$ for both ship types.



A small number of measurements from Italian caravels in the 15th century, found by the historian Furio Ciciliot, and with LTBRs from 2.9 to 3.1;

Furio's caravel (1543) Varazze:

Lunghezza goe 26 (19.5 m)

Sopra l'incenta e larga di palmi 27 (6.75 m)

Alta palmi 19 (4.75 m)

$E/M = 2.89$



Fernandez' caravels (1616) have the following dimensions:

11 rumos caravel:

Keel = 16.94 m; Manga = 6.41 m; Pontal (convés)= c. 9+1+6+1 pg = 4.36 m

Eslora (convés)= c. 21 m

LOA = 23.23 m

E/M = 3.28

12 rumos caravel:

Keel = 18.48 m; Manga = 7.19 m; Pontal (convés)= c. 10+1+6+1 pg = 4.61 m

Eslora (convés)= c. 23 m

LOA = 25.75 m

E/M = 3.20

Based on the ratios and the 1530s formula indicated by Jose Luis:

$$\begin{aligned}\text{Tonnage [toneles machos]} &= 19/20 \times L[(B/2+H)/2]^2 / 8 \\ &= 19/640 \times L(B/2 + H)^2\end{aligned}$$

Caravels should have the approximate dimensions/capacities:

8 codos de manga → 53 toneles – 28 codos de eslora

9 codos de manga → 76 toneles – 31.5 codos de eslora

10 codos de manga → 104 toneles – 35 codos de eslora

1 codo de ribera = 57.5 cm

Based on the 1530s formula indicated by Jose Luis, Fernandez' caravels would have the following tonnages, considering all *palmos* as *palmos de goa* and calculating the *eslora* on the lower deck:

11 Rumos caravel: 100 *tonéis* (*manga* 25 pg = 11 *codos*)

12 Rumos caravel: 138 *tonéis* (*manga* 28 pg = 12.5 *codos*)

If we would consider the *eslora* on the upper deck, the tonnages are significantly increased:

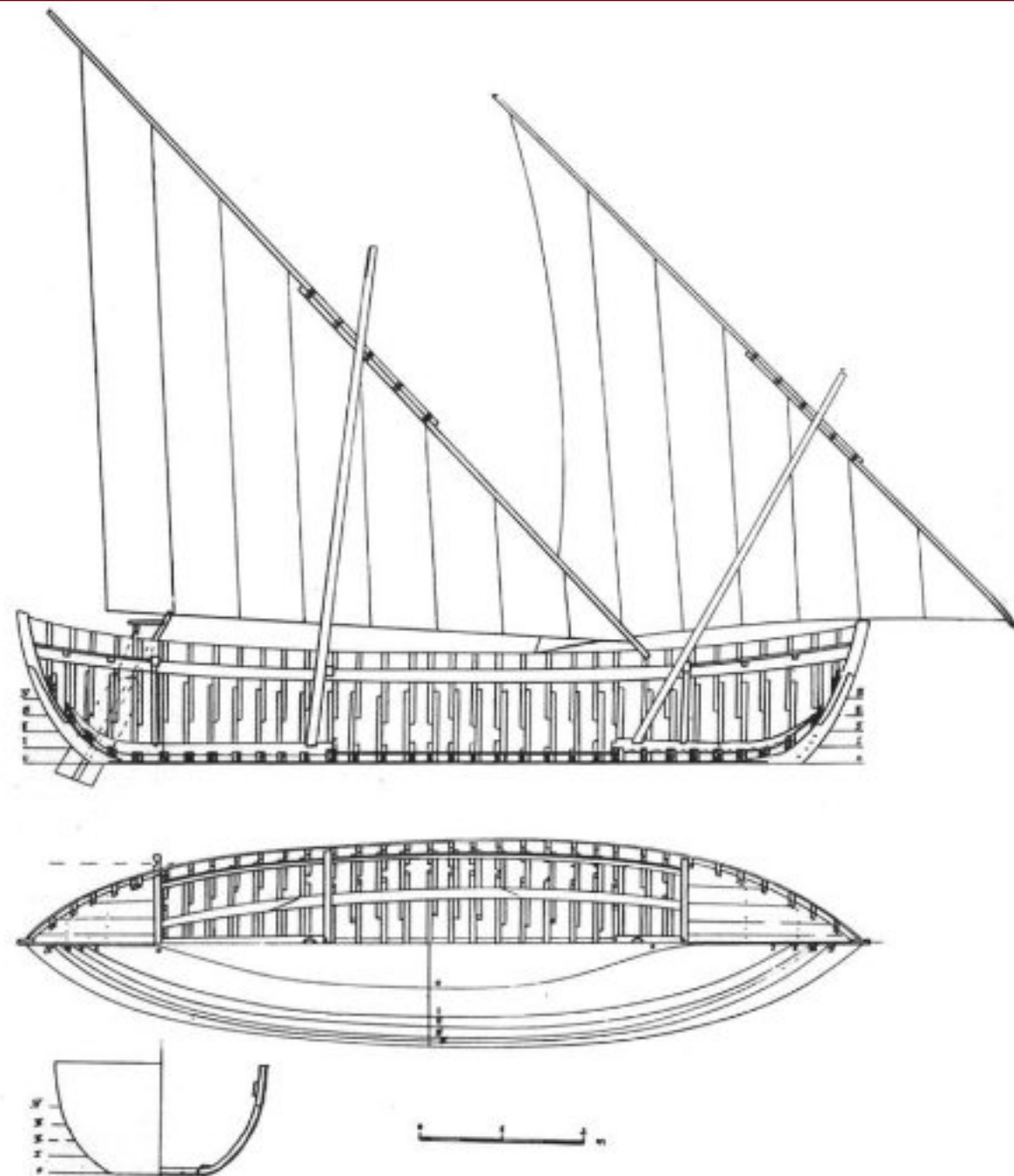
11 Rumos caravel: 164 *tonéis*

12 Rumos caravel: 216 *tonéis*

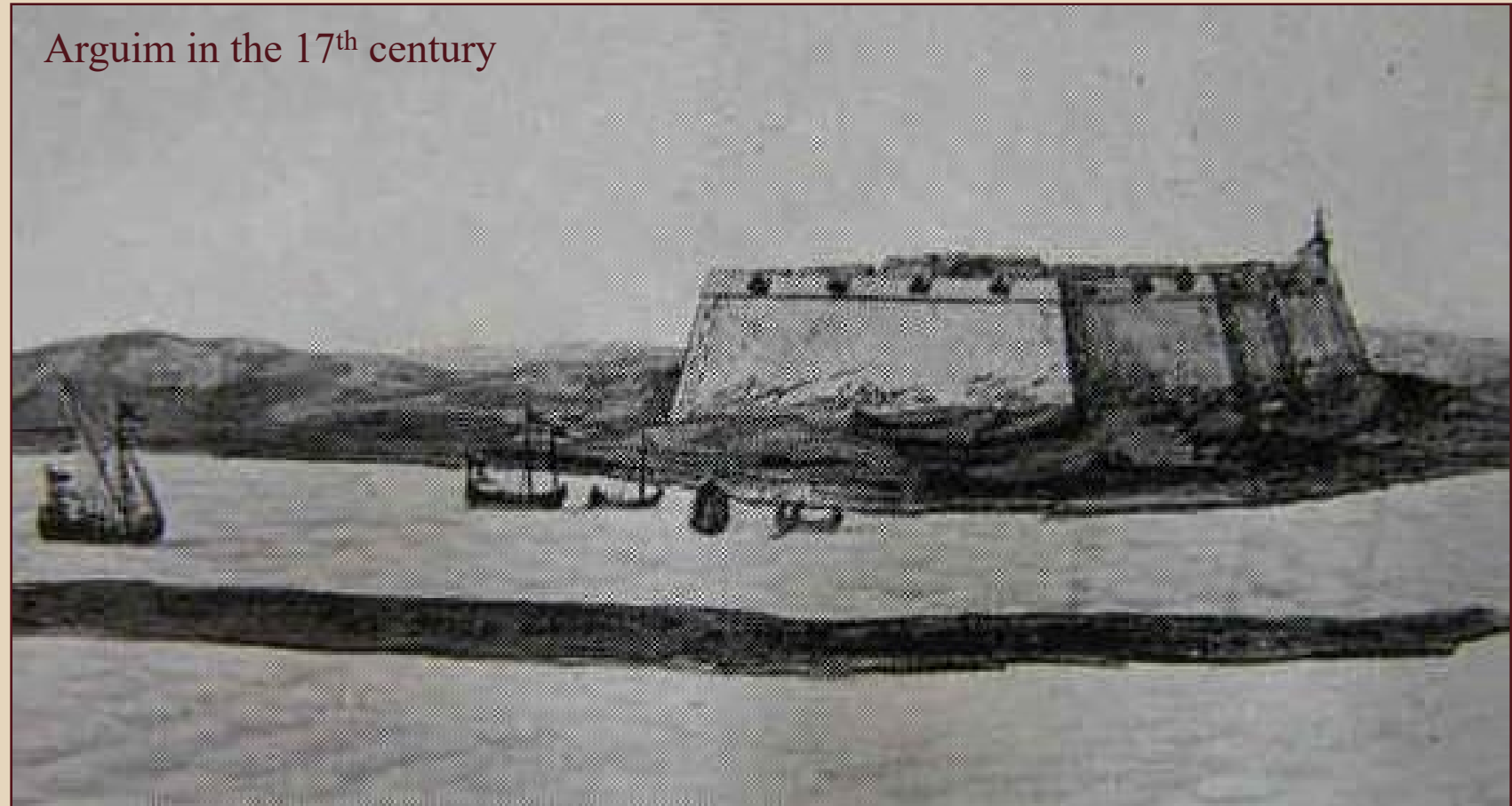
7. Caravelões

It seems that the smaller caravels were referred to as caravelões.

Carlos Francisco Moura indicates 2 or 3 masts, not necessarily with a quarterdeck.



Paulo Monteiro transcribed two early 16th century documents relating to caravelões de Arguim, that describe 3-masted vessels with bowsprit, square sails on the fore and main masts, and a lateen sail on the mizzen.



One of these *caravelões* had a crew (*companha*) of nine: pilot, six sailors, and two apprentices.



In the mid-16th century Fernando Oliveira states that crews should be calculated as follows:

Up to 10 *tonéis*: 2 sailors, 1 apprentice;

10 to 20 *tonéis*: 3 sailors, 1 apprentice;

20 to 30 *tonéis*: 4 sailors, 2 apprentices;

Above 30 *tonéis*: 1 sailor / 4 *tonéis* & 1 apprentice / 3 sailors.

Master and pilot are counted as sailors.

Paulo Monteiro's crew indicates a vessel with 25 to 30 *tonéis*.

One of the documents (1508) is particularly interesting because it refers a bowsprit, fore and mainmasts, and a bonaventure mast with its yard.

Although there is no mention of a mizzen mast and yard, there is one mizzen sail, and one mizzen halyard (ostaga).

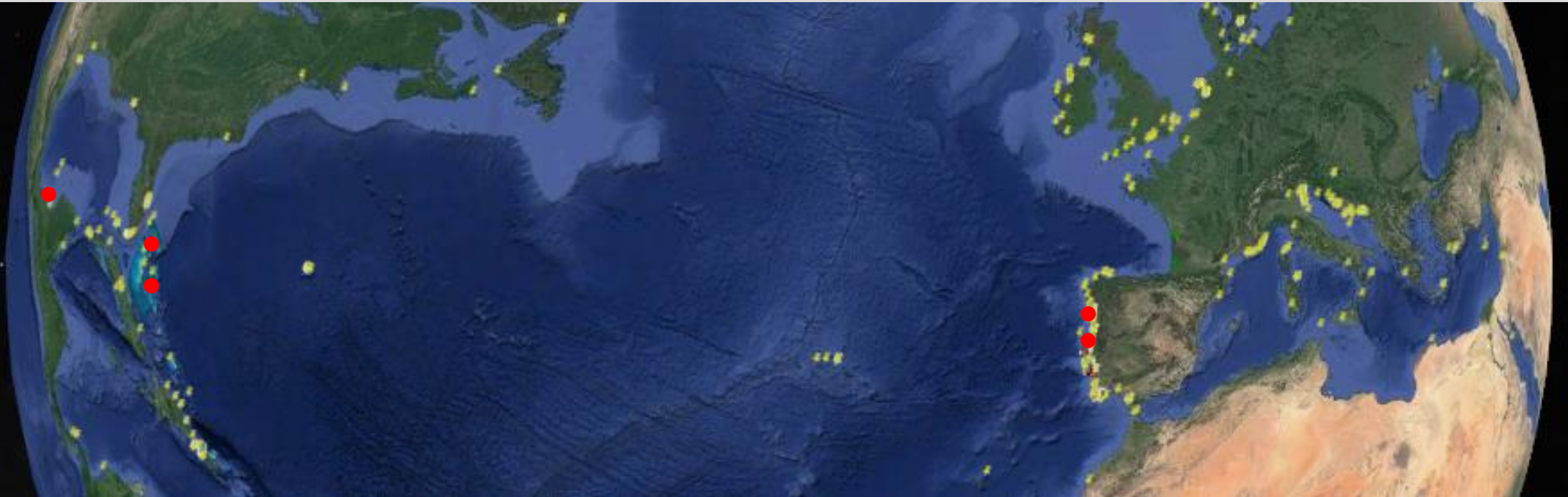
Is this just a mistake, or were there caravelões with 4 masts?



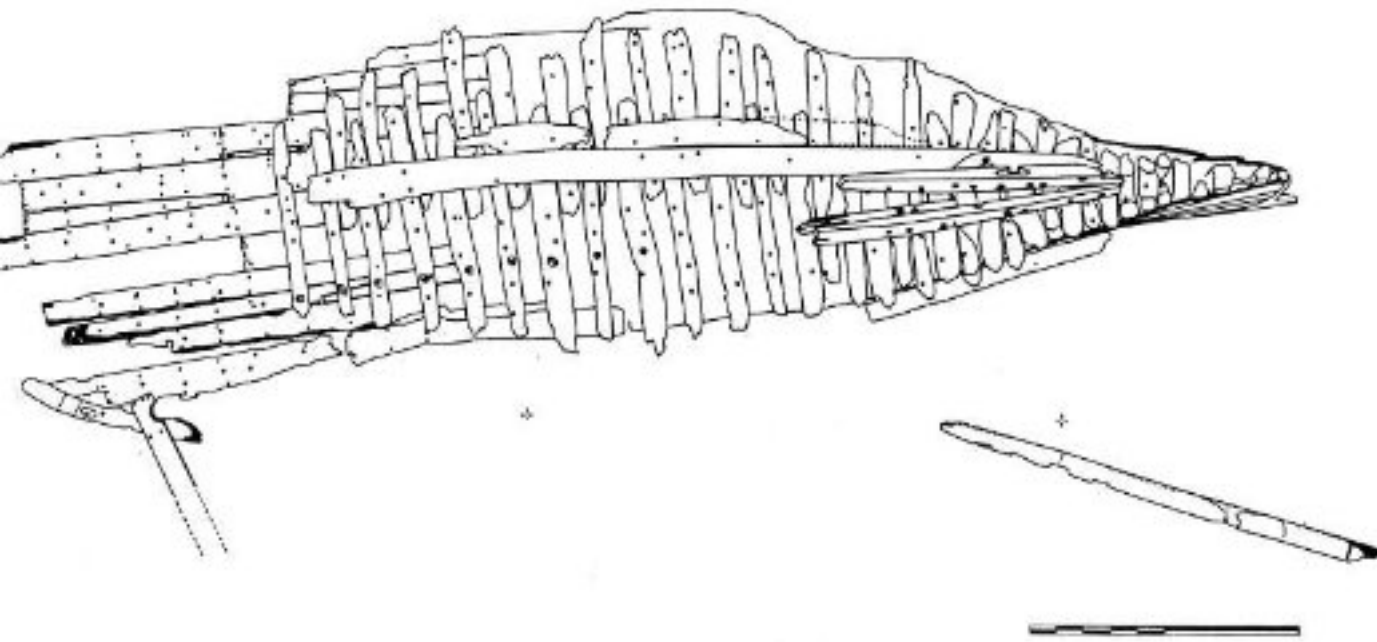
Archaeology

There are five (although remotely) possible caravel shipwrecks:

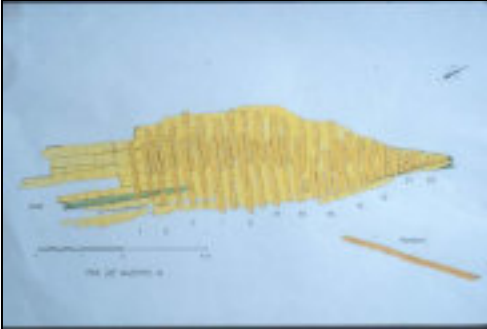
1. Aveiro A (Portugal), not fully published;
2. Molasses Reef (Turks & Caicos), w/ almost no timber preserved (square rigged);
3. Highbourne Cay (Bahamas), not fully studied;
4. Playa Damas (Panama), not fully excavated (square rigged);
5. Esposende 1 (Portugal): not yet excavated.



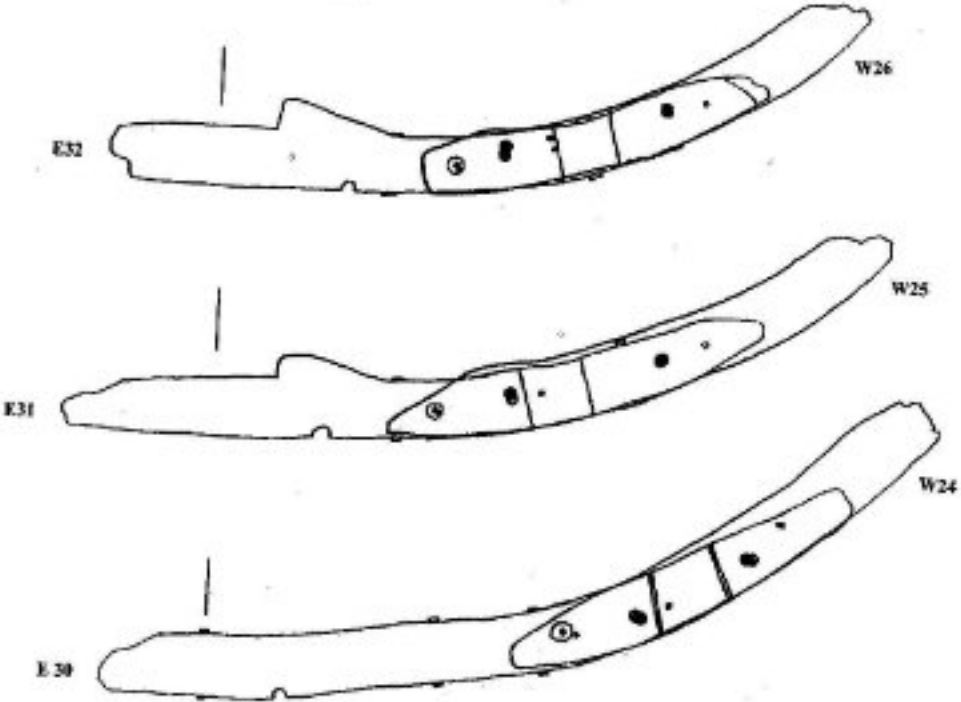
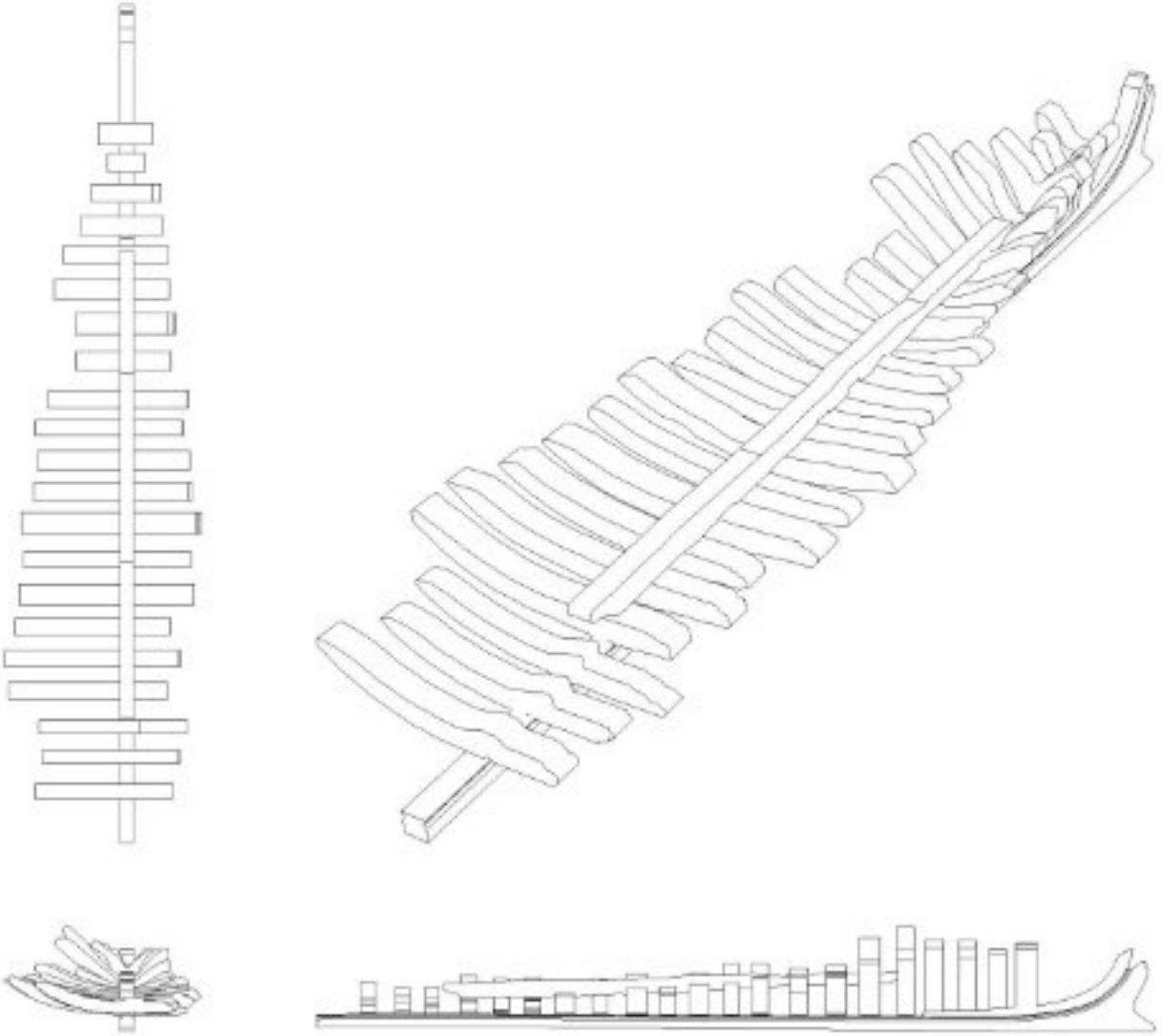
Aveiro A Shipwreck



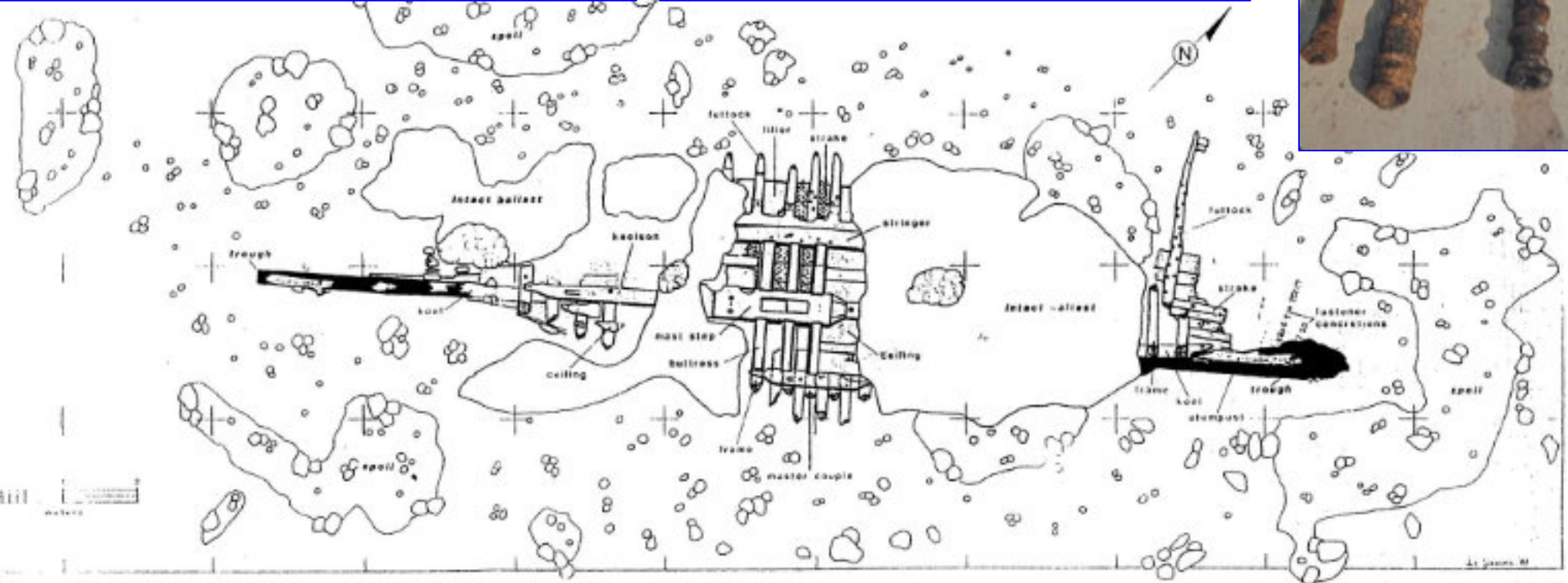
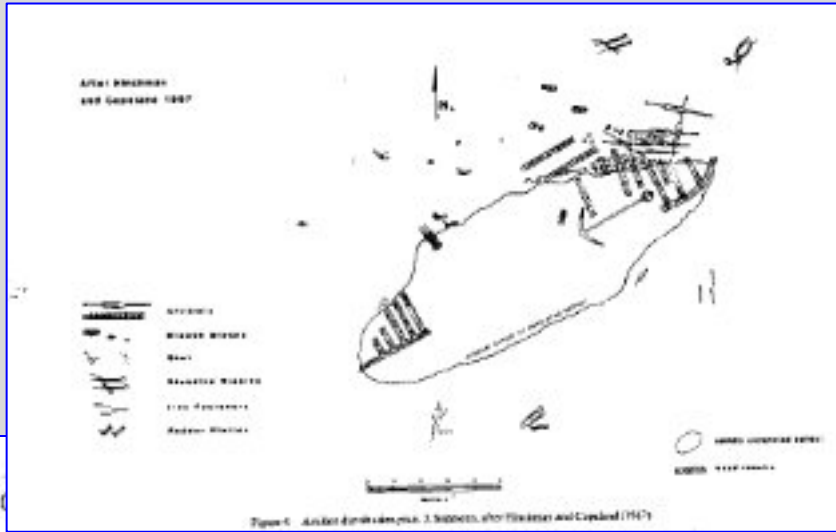
Dated to 1450-1475, it was excavated by F. Alves and partially published.

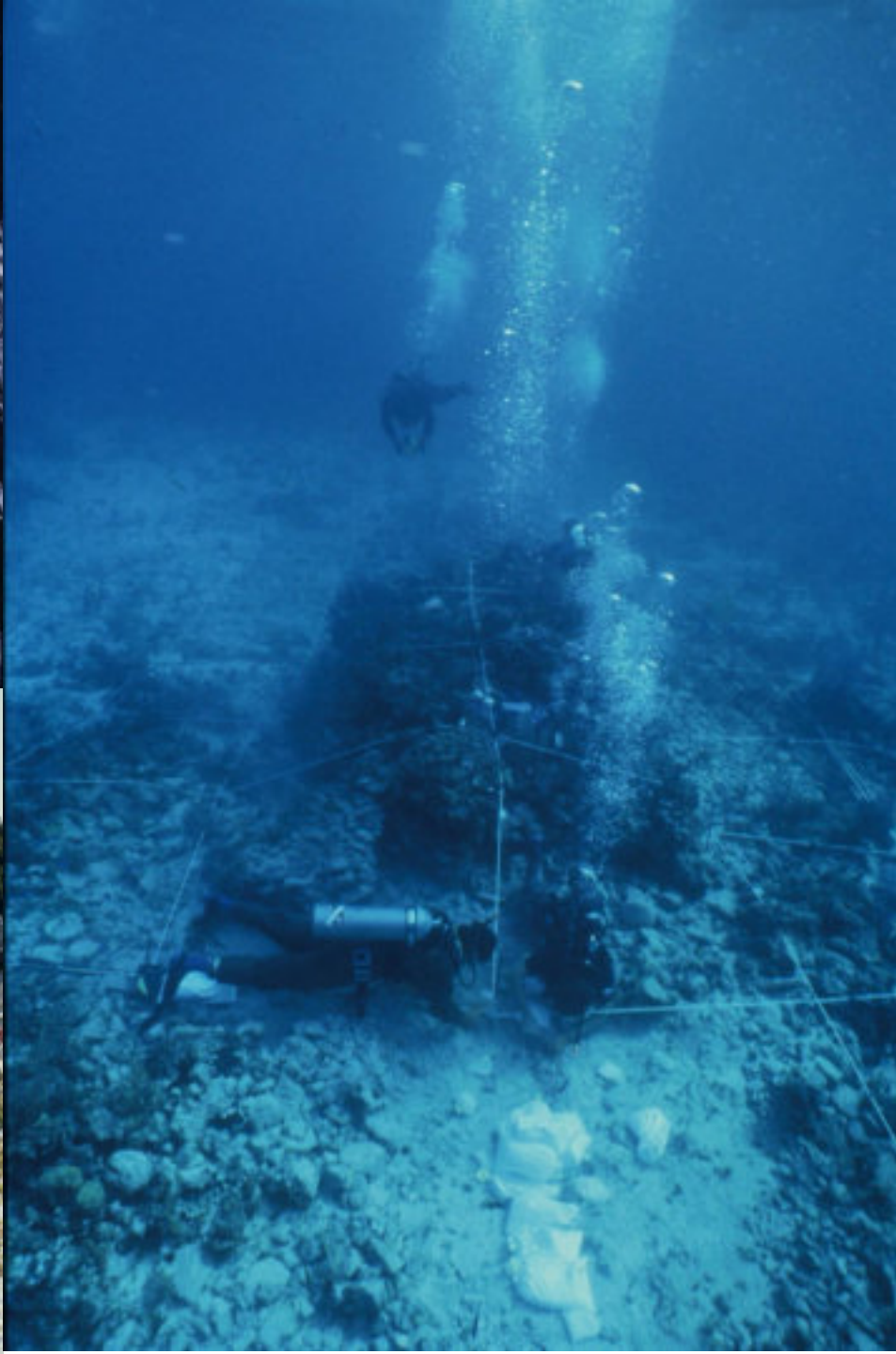


Aveiro A, c. 1450.



Highbourne Cay Shipwreck





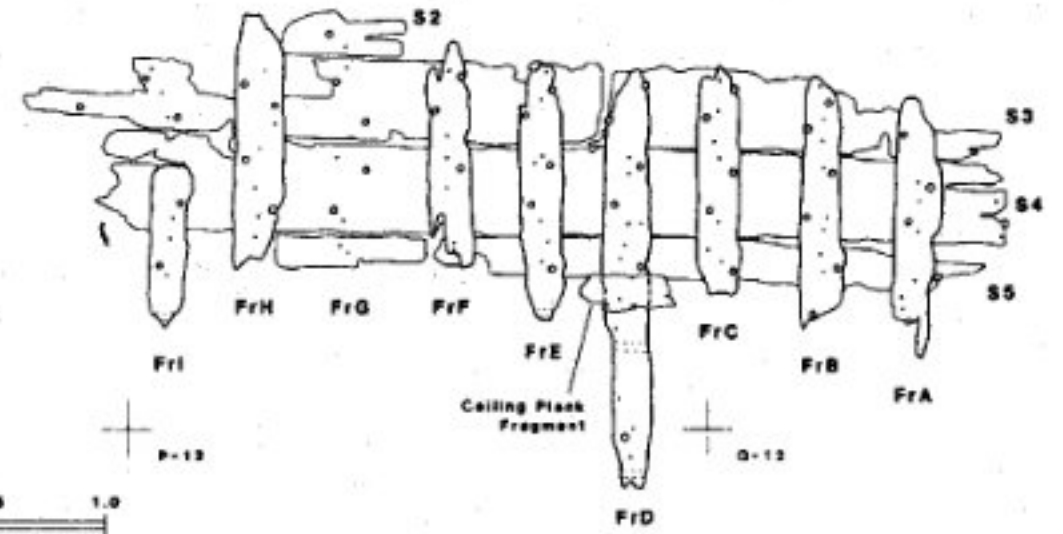
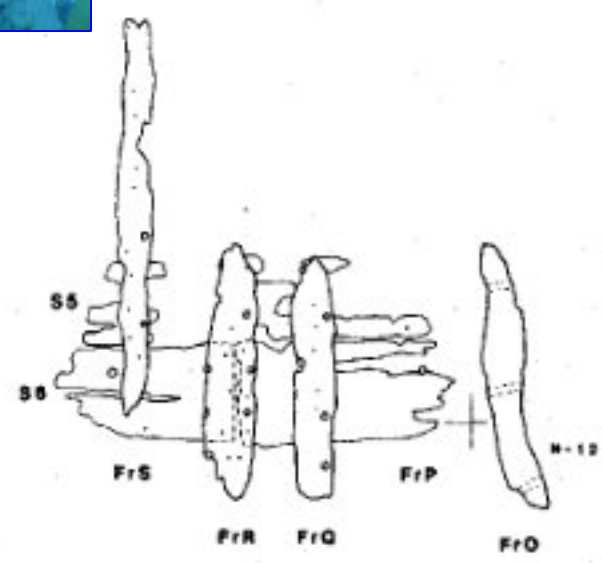
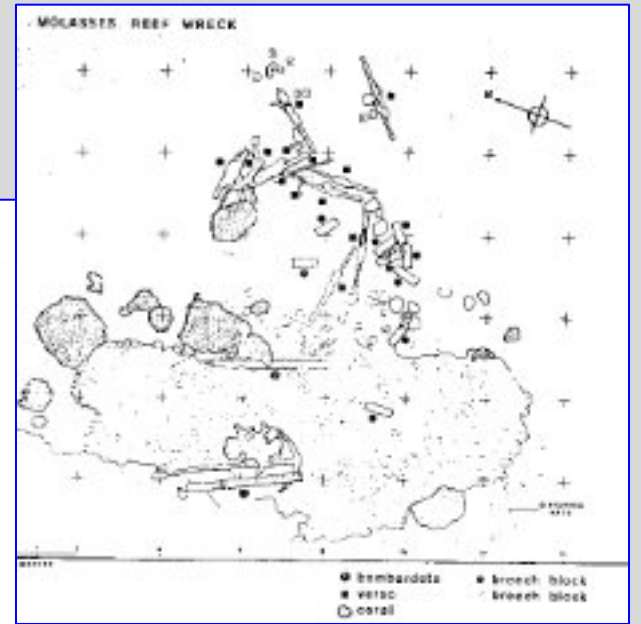
Highbourne
Cay was
dated to
1500-1525
was found
and destroyed
by treasure
hunters in the
1960s.

Molasses Reef Shipwreck:



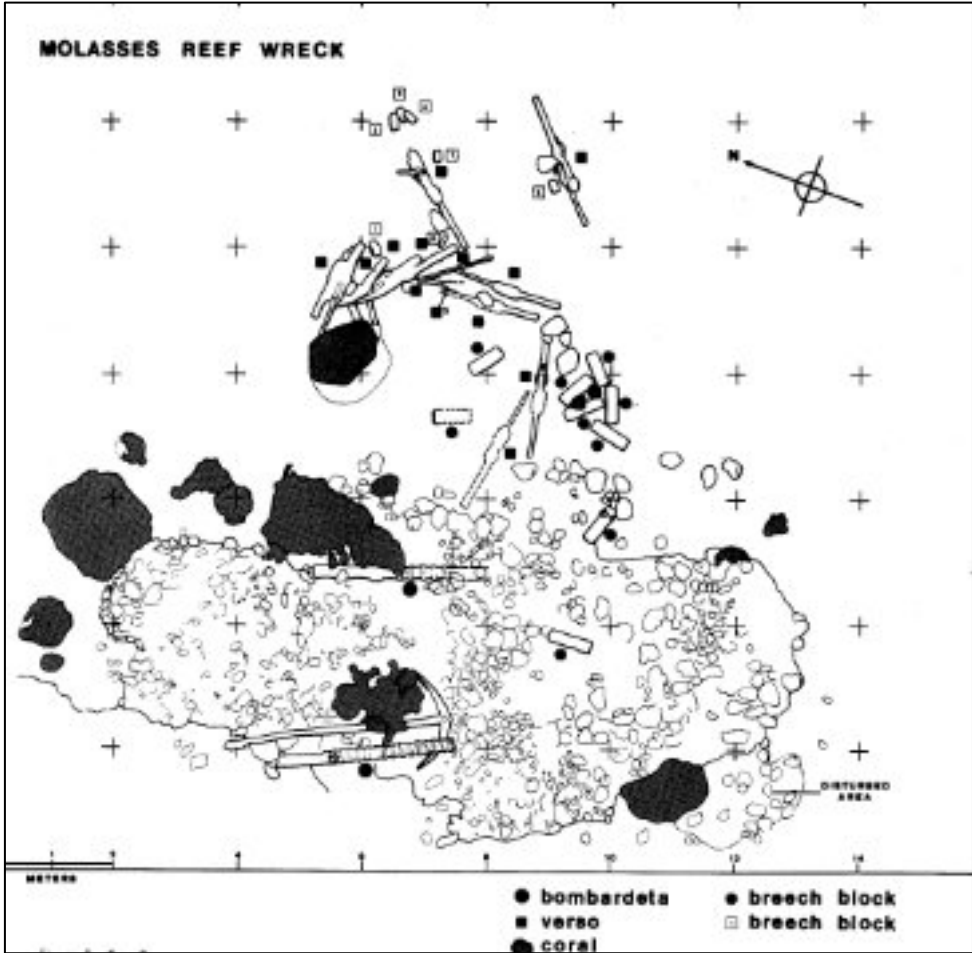
MOLASSES REEF WRECK

Preliminary Wood Plan



- square nails
- trenails

Molasses Reef was dated to 1500-1525, found and destroyed by treasure hunters in the 1960s. Studied later, in the 1980s, after treasure hunters dynamited it, revealed some details.



Studied later (2017), the remains were protected and reburied.

**The technique we are using here is called
Video Frame Photogrammetry.**

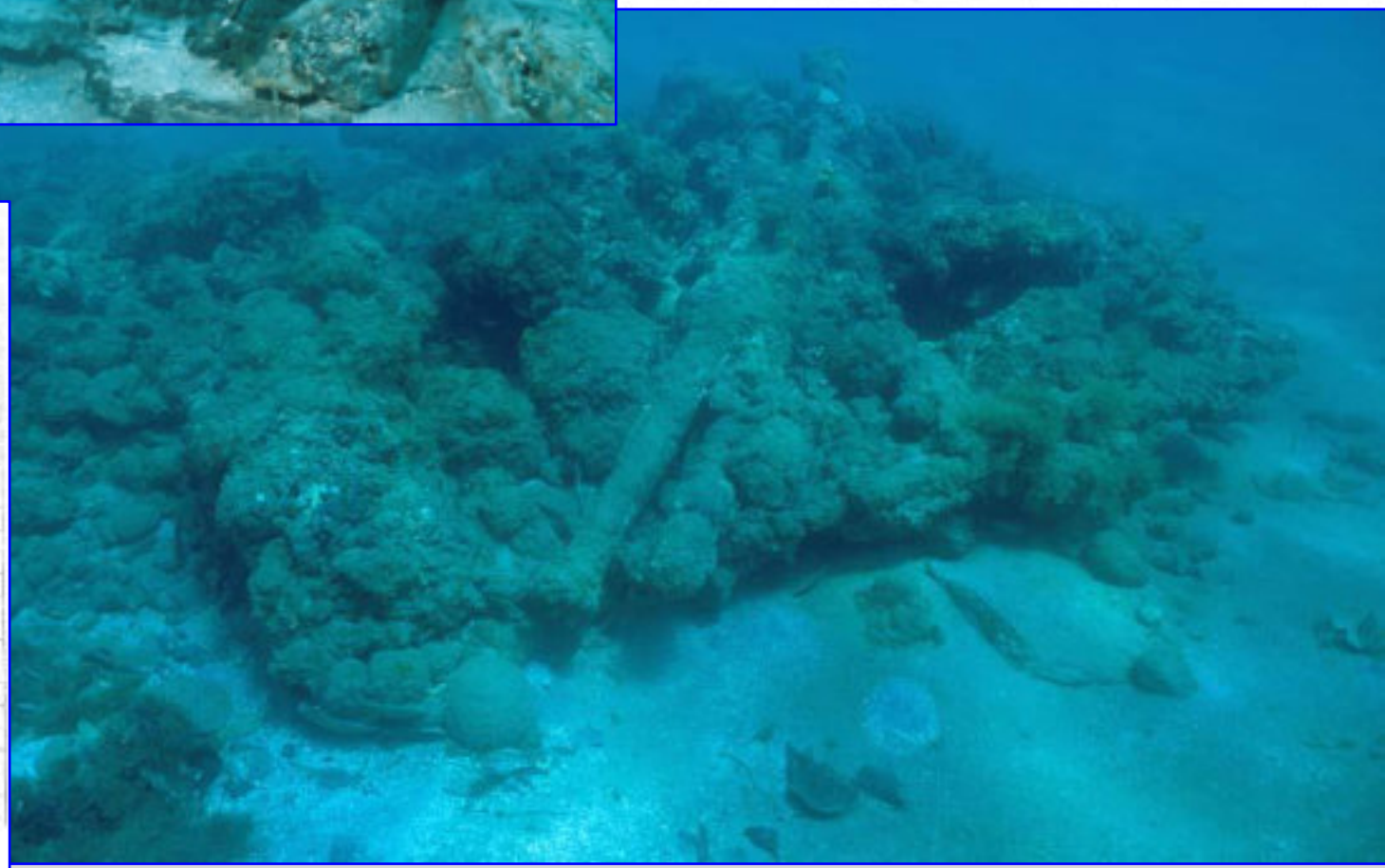
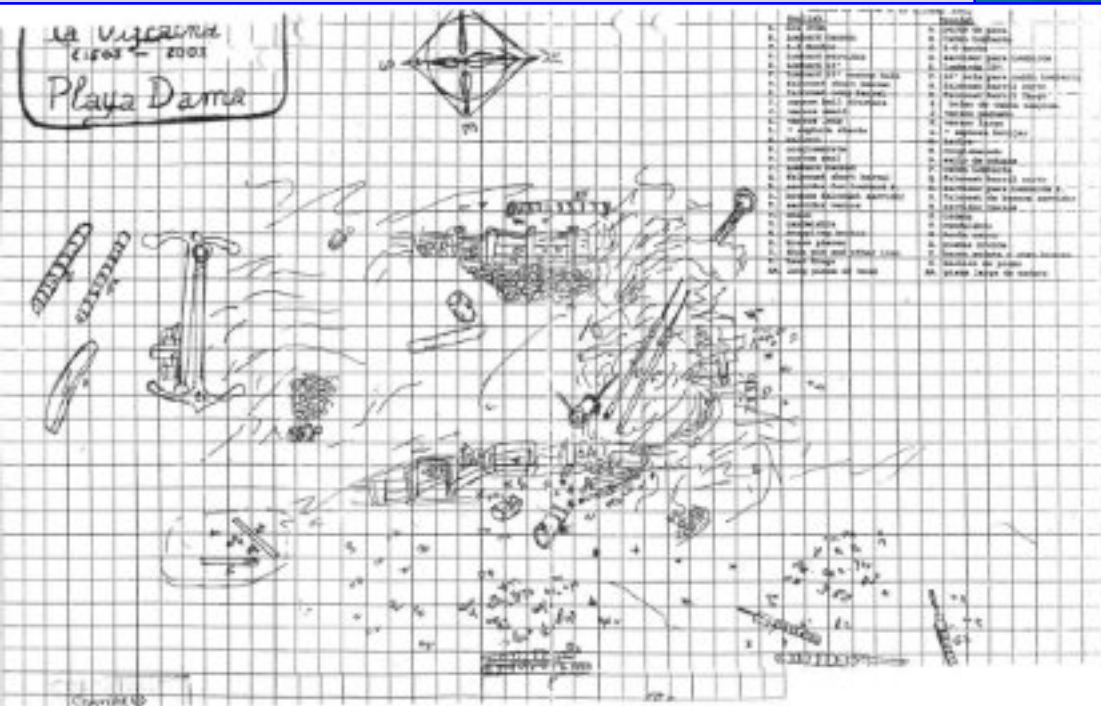


04:08



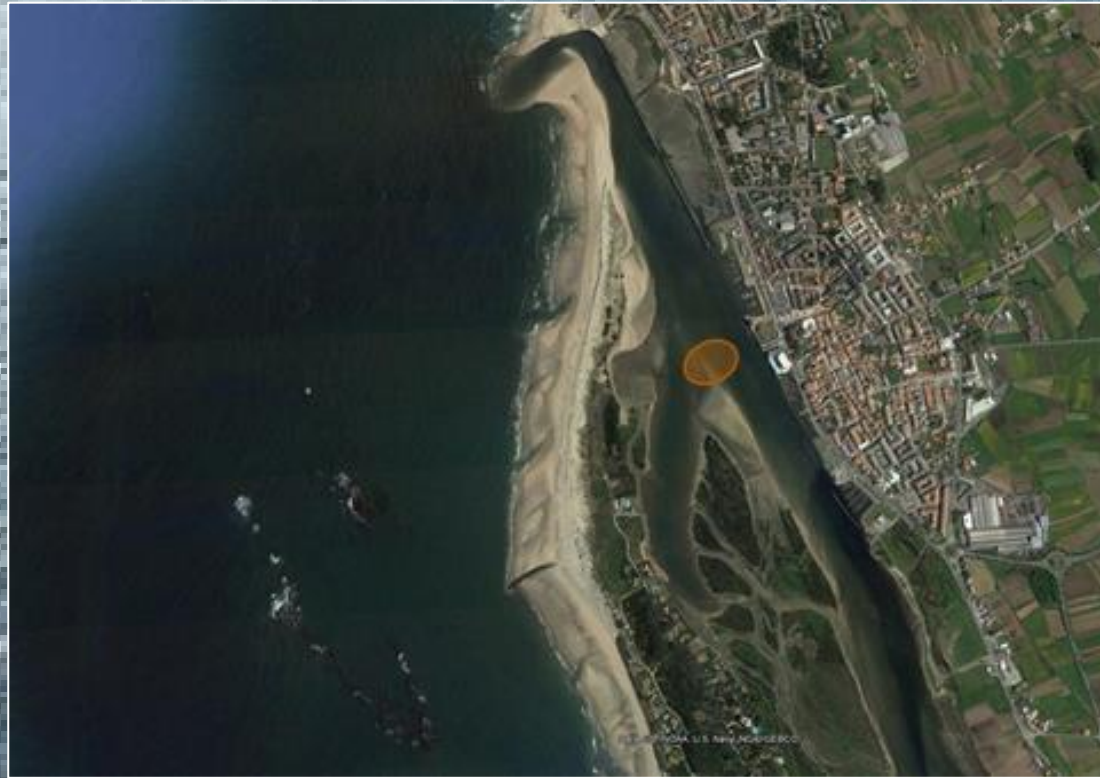
Playa Damas Shipwreck

Dated to c. 1530, it was destroyed by treasure hunters.



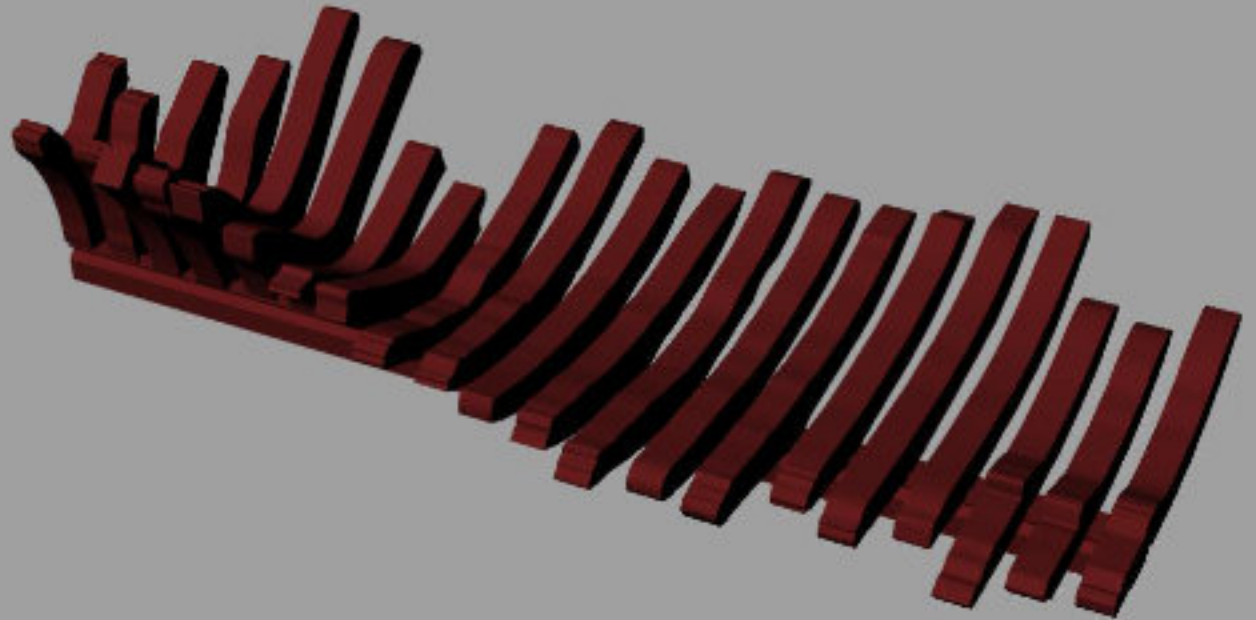
Esposende 1 Shipwreck

Not studied. Not dated (there is a 17th century date).



There are far more questions than answers when we think about reconstructing any caravel type, but we believe that the best way is to try.

Thank you!



Partial 3D model of the Aveiro A hull.