



**HAL**  
open science

# Hypothetical reconstruction of the Dramont E Shipwreck

Pierre Poveda

► **To cite this version:**

Pierre Poveda. Hypothetical reconstruction of the Dramont E Shipwreck. XIIth International symposium on boat and ship archaeology,, Nergis Gunsenin, Sep 2009, Istanbul, Turkey. pp.331-336. halshs-01807681

**HAL Id: halshs-01807681**

**<https://shs.hal.science/halshs-01807681>**

Submitted on 15 Jan 2019

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# 46. Hypothetical Reconstruction of *Dramont E* Shipwreck

*Pierre Poveda*

---

## **Introduction**

The following research is the result of a M.A. thesis submitted in December 2008 to the University of Provence (Université d'Aix-Marseille). The principal objective of this work was to establish an original hypothesis of reconstruction of the *Dramont E* shipwreck, which could be as loyal as possible to the archaeological remains. The reconstruction is based upon the available records of the preserved architectural parts. In particular, I intended to remedy the deficiency of the hull form reconstruction for this noteworthy shipwreck.

The evidence of shipwrecks involved in the maritime trade in the Western Mediterranean during the 5<sup>th</sup> century AD is very limited (Parker 1992: 14). Thanks to its exceptional conservation, the *Dramont E* shipwreck is the only one in this area and for this period, to have delivered a sufficient amount of data about the naval architecture.

This work deals also with some collateral problems: firstly on how to give attention to the treatment and the re-evaluation by computer of the primary restricted documentation, from what it has been possible in a second time to produce a computerised three-dimensional model of the ship, intended to be used in a hydrostatic analysis. Finally the results of this analysis were also considered as a supplementary reference to estimate the validity, to a certain extent, of our restitution, especially regarding the draught, the freeboard and the loading conditions.

## **Discovery and Excavation**

The *Dramont E* shipwreck has been discovered by chance in 1965, lying 42 m deep, near Cape Dramont on the present shore of Cote-d'Azur. Since its discovery, the shipwreck has been largely plundered<sup>1</sup> by unscrupulous divers until an exhaustive

excavation began in 1981 under the supervision of Claude Santamaria (Santamaria 1995: 15-17).

During the survey of 1966, the presence of the shipwreck was revealed by a huge mound of amphoras. The entire site was restricted in an egg-shaped area, 9 m long and 4 m wide. A meticulous examination of the visible cargo leads to expectations of finding a large quantity of well preserved wood remains from the hull. Finally a large and homogeneous assembly of wood appeared. The remaining architectural parts, most of them belonging to starboard part of the boat, were spread on a large surface, 10.04 m long and 5 m wide (3.18 m belonging only to starboard part).

The underwater drawings and recordings, executed using the Cartesian reference system (x, y, z), presents a satisfying global precision despite the depth and the restricted means. However, the recordings of the extended area, such as the plan drawing of the planking, entail a wider margin of error restricting their use in our work. In spite of this, the overall corpus of drawings permitted to generate a reliable reconstruction of the drawing lines. The hypothetical nature of the reconstruction had to compound with the usual constraints but also with the obstacle of limited and erratic data. To take up the classification proposed by Patrice Pomey (Pomey 2003: 64) concerning the study and the reconstruction of the two Greek shipwrecks discovered under square Jules-Verne in Marseille, the *Dramont E* shipwreck deals with a 'probable reconstruction' more than a 'sure reconstruction' (Fig. 1).

## **Architectural Details**

The construction typology is mainly classic, very similar to those already observed on various shipwrecks dating to the earlier period of the Roman Empire:

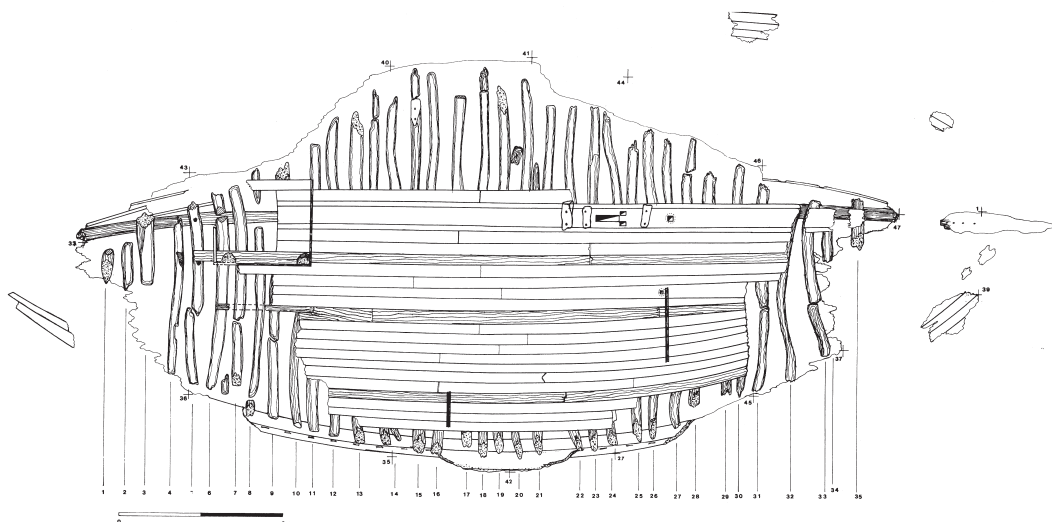


Fig. 46.1.  
Drawing:  
C. Santamaria, from  
Santamaria 1995.

shell-first construction, a simple carved planking, assembled using the mortise-and-tenon technique, a composite framing, alternating half frames and floor-timbers, the using of metallic drifts to join up five floor-timbers to the keel and finally the presence of a mast-step linked to the frames by two parallel 'carlingots'. The *Dramont E* shipwreck can be connected with the Roman Imperial Type, as it has been defined by Patrice Pomey (Pomey 1998: 49-72). Nevertheless we have to note a main divergence of the *Dramont E* with this typology. From the beginning of the 1<sup>st</sup> century AD we observe a generalisation of flat bottoms in the Roman merchantmen of the western Mediterranean, associated with a simplified form of garboard, this is absolutely not the case of the *Dramont E* which has conserved a slightly curved garboard. Otherwise, the shipwreck has revealed some other unusual features of construction which have to be noted: the sizeable dimensions of the keel (30 cm depth, 20 cm wide), unexpected on a ship of this size, and the chronic use of crooked wood for the framing which gives an overall impression of a neglected work even if it confers a major solidity and cohesion to the ship.

### Reconstruction Process

Regarding the reconstruction of the underside parts of the hull, the chosen method is absolutely conventional: a rigorous respect of the archaeological remains, complemented by punctual corrections when formal distortions are certified. Concerning the restitution of upper sides, the superstructures and the rigging, due to lack of archaeological remains I had to back up my hypothesis on other types of sources: iconographic evidence and comparable archaeological remains.

### Hull Form

The remaining part of the hull induces to restore a very wide hull at amidships proportional to its overall length (Fig. 2). Lengthening the extremities could compensate this ratio. However the shape of the frames conserved around bow and stern make this adjustment impossible.

Eventually, the ship is 14.10 m over all for an extreme breadth of 6.15 m at amidships. Such dimensions generate a very low ratio of lengthening of 2.29. Even if this range of ratio seems incredible, it is however not so uncommon on roman merchantmen: the *Saint-Gervais 3* (Liou & Gassend 1990: 258) and the *Port-Vendres 1* (Roman 1997: 117, 159) shipwrecks present ratios in the same range: respectively 2.28 and 2.05. This large breadth at amidships engenders a significant gain of volume for the fret and at the same time a large wetted area.

The finding of the right height for the freeboard turned out to be the most arduous problem to resolve. Two aspects have been helpful to find out the most plausible configuration:

- On the one hand, it was possible, in reasonable extents, to base the reconstruction of the freeboard height of the *Dramont E* by analysing the ratio length-over-all height (freeboard + draft) of two iconographic representations, both displaying merchant ships relatively close looking to our hull reconstruction: the ship shown on the votive bas-relief from the *Quinquennales Fabri Navales* of Ostia (Torlonia Collection, 2<sup>nd</sup> -3<sup>rd</sup> centuries AD. Pomey 1997: 118) and the ship represented on the grave stone of Kalleinikos (Archaeological Museum of Istanbul, 3<sup>rd</sup> century AD. Basch 1987: 481).

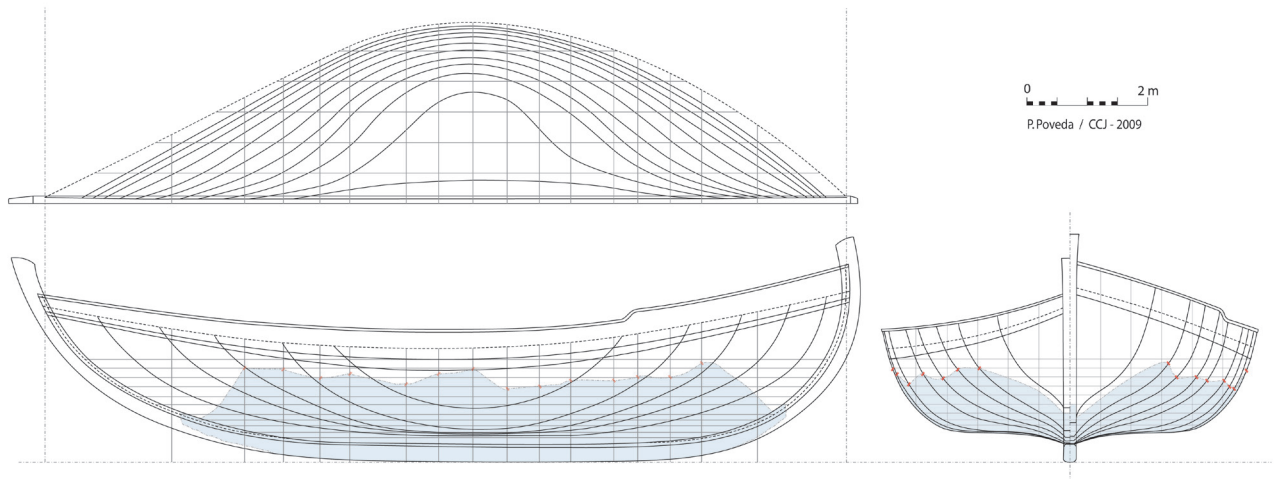


Fig. 46.2. Drawing: Author.

- Another factor could give us some useful information: the potential positions of the hypothetic third and fourth wales in comparison with the dimensions of the first two (Fig. 2).

Concerning the ratio (length-over-all divided by the entire height, approximately at amidships from the bottom of the ship to the top of the bulwark): they are 4.87 for the bas-relief of Ostia and 6.88 for the grave stone Kalleinikos. The over-all length of our restitution being 14.10 m, such coefficients would lead to a reconstruction of the total height between 2.04 m and 2.89 m. Taking into consideration the dimensions and relative positions of the preserved wales, the restitution of a height of 2.89 m (bulwark included) seems a bit too large. In such a configuration the level of the sheer line at amidships would be 2.50 m engendering the reconstruction of not less than 5 wales. Without doubt this is an improbable original state: this solution was quickly dismissed. On the other hand the presence of a fourth wale was an eventuality which could be considered. However this eventuality will not be taken into consideration in the present paper, favouring a more traditional schema consisting of 3 wales: a lower corresponding approximately at amidships with the water line, a medium one and an upper one which define the

sheer line all over the length. Finally, the total height is 2.18 m, meanwhile the height of the freeboard and the draught is 1.90 m.

#### Architectural Structures

The quantity of vestiges does not permit the reconstruction of all the details of the original internal structures. The various archaeological sources available for the Roman Imperial Period are too limited to allow a precise reconstruction based on comparable shipwrecks. Nevertheless, our objective to produce a hydrostatic analysis requires the production of a load sheet as accurate as possible: evaluating the importance of all the weights and positioning them in the three dimensions. So it was preferable to do the minimalistic reconstruction for the unpreserved structures and superstructures: basing our hypothesis on few iconographic and archaeological examples, especially on the remaining parts observed on the *Laurons II* shipwreck. Particularly well-preserved, this shipwreck gives us the unique point of reference for a reconstruction of upside parts: particularly for the deck construction and for the rudder system (Gassend, Liou & Ximénès 1984: 91-99; Gassend 1998: 197-201) (Fig. 3).

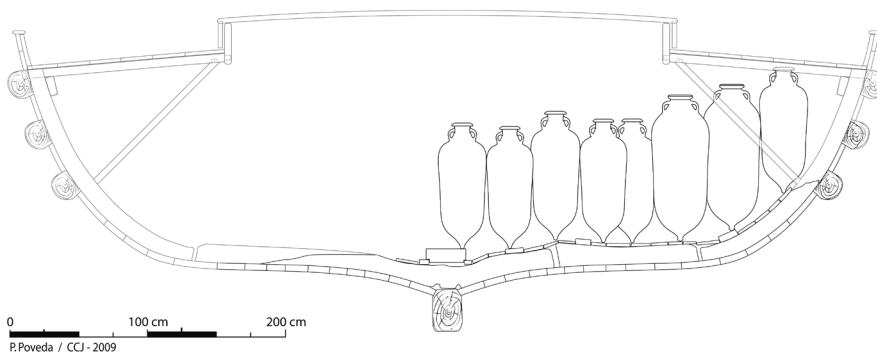


Fig. 46.3.  
Drawing: Author.

In the end, the three-dimensional model used for the hydrostatical experimentation is composed by some well defined parts (keel, bow, stern, planking, framing, ceiling planks, mast step, wales) and some less detailed architectural parts (deck planking, deck beams, hatch, pillars, knees, mast, yard, rudder, rudder protection)<sup>2</sup>.

### *Hydrostatic*

Therefore, the lines drawing and the reconstruction of the major structures permit us to carry further the analysis on our hypothesis giving greater importance to the hydrostatic and stability of the ship. Prior to making any calculations it is absolutely necessary to determine the real draft and the correct trim of the ship. This implies measuring some essential data on our reconstruction: load sheet (equivalent here to the light displacement condition), deadweight capacity and loaded displacement.

First, in the usual configuration of a traditional merchant ship, without any particular ballast and a limited cargo, we can notice that a reduced draft and the rather high vertical centre of gravity would reduce significantly the transversal stability of the ship. On other hand, a large sinking (large draft) may guarantee a good stability (reducing the distance between the centre of buoyancy and the centre of gravity) but would reduce the freeboard and the security margin to limited angles of heeling to avoid a flooding.

Regarding the *Dramont E* ship, one method seemed to be pertinent to determining a correct flotation condition: we tried to measure the initial loaded displacement by estimating firstly the light displacement and secondly the deadweight capacity. In this way we intended to obtain the draught and the trim for one particular condition of loading: the configuration just before the wrecking.

In a second time, verification about the flotation, this time more empirically, seemed very appropriate. It consists in determining the maximal angle of heeling the ship must present before it sees its sheer line submerged. This method does not intend to determine directly the draft but may help us to judge if the transversal stability and the reserve of buoyancy are sufficiently safe in the specific loading conditions previously determined.

### *Measuring the Light Displacement: The Load Sheet*

The hydrostatic analysis rests on the computerized study of a three-dimensional model. As we already

said the major advantage of the use of a three-dimensional model is to facilitate and improve the measurement and the positioning of all the weights. Thanks to the wood analysis done by Frederic Guibal (Santamaria 1995: 181-190) on a large part of the wood remains, we were able to assign to every piece the specific density of its essence and in this way to get a first approximated weight of the ship: 7.368 metrics tonnes.

We have to add to this principal weight an additional one corresponding with all the small elements not taken into account in our calculation: deck equipments, ropes, sails, anchors, etc. We estimate this additional weight at about 500 kg. To simplify we will take a light displacement of 8 metric tons into account

### *Estimating the Weight of the Freight:*

#### *A Deadweight Capacity*

Taking as a reference the starboard part of the cargo (a great amount of amphoras seems to have kept their original positions on this area), we tried to reproduce the entire freight. The shipwreck was entirely composed by ceramics coming from the roman province of Africa, among which the amphoras were in majority over a small set of. Three types of amphora can be easily distinguished: large cylindrical amphora of type Keay XXXV, small cylindrical amphorae of type XXV and small *spatheion*. It is noticeable that the positioning of the amphoras in the hold seems far from being rationalised and optimised. Indeed, the large cylindrical amphoras take up the majority of the space in a total random mode: neither staggered rows nor square arrangement can be detected. Without doubt this has been done intentionally with the aim of filling the spaces with the small cylindrical amphoras and the *spatheion*, giving the cargo a safe homogeneity and cohesion.

The existence of a second layer of amphoras is still an unknown factor: nor the excavation, neither the restitution of the hull has convincingly resolved the problem. Taking into account our hypothesis of reconstruction, the presence of this second layer appears unrealistic: the remaining space for a second layer is too reduced and does not permit a satisfying and safe stowing.

Finally, the weight of the cargo is distributed in the following way:

- 218 amphoras Keay XXXV: 16 930 kg.
- 110 Keay XXV: 2 200 kg.

- 44 *Spatheion*: 440 kg.
- A load of African Red Slip ware: approximately 1 000 kg.

For a total weight of: 20,57 metric tons.

*Loaded Displacement Estimated from Archaeological Data*

Conclusively, the loaded displacement of *Dramont E* ship should be established around 28.5 metric tons (addition of light displacement and deadweight). In salt waters this weight is equal to a displacement volume of 27.75 m<sup>3</sup> (the specific density of Mediterranean sea: 1.027 kg. lt.). This volume corresponds with a draft of 1.33 m on our model.

In this particular configuration, the ship must present a heeling of 10.5 degrees to get its sheer line to the water level. Even if this figure is only indicative, she reveals a margin of security reduced to the minimum (Fig. 4).

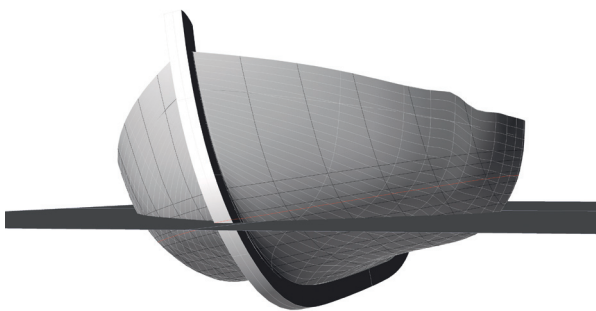


Fig. 46.4. Drawing: Author.

*Centre of Gravity/ Centre of Buoyancy*

The hull form and the floatation study have given the opportunity to determine some noticeable data about the ship: longitudinal and transversal centres of buoyancy, bloc and prismatic coefficients. The advanced hydrostatic analysis provides major facts about the transversal stability: among others it is certainly the production of the cross curves (or ‘KN curves’) for angle of heeling between 0 to 180 degrees which is the most significant. Otherwise, knowing exactly the position, on a Cartesian x, y, z reference, of all the centres of gravity of every elements it was easy to determine the vertical and longitudinal position of the centre of gravity (LCG and VCG) of the entire ship in a full loaded condition. Finally the centre of gravity is positioned right in the middle of the transversal axis, 6.41 m from the stern on the longitudinal axis, and 1.21 m high (from the top of the keel: in other words KG distance) on the vertical axis.

*Transversal Stability*

Thanks to the cross curves we know exactly for each degree of heeling the value of KN distance. Using the following formula we can obtain for each angle the value of the righting arm (GZ) expressing the transversal stability of the ship:  $GZ = KN - KG \sin\Phi$  ( $\Phi$  representing the value for the angle of heeling) (Fig. 5).

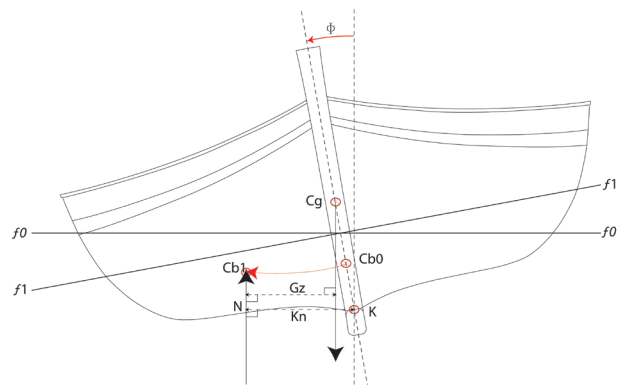


Fig. 46.5. Drawing: Author.

The overall curve shows a very good initial stability, and a significant maximum value for the righting arm of 0.811 m which corresponds with a high degree of heeling of 34 degrees. However, those figures can be questioned. Indeed, except for the fact that the deck is quickly submerged, lowering the righting force, we also have to mention that after a heeling of 29.9 degrees it is highly probable that the ship began to be flooded, the hatch coming below the water level. The stability curve presented in Figure 6, depicts in fact an intact and undamaged stability. Consequently, its profile is unrealistic for values over 29.9 degrees and trustworthy under this angle (Fig. 6).

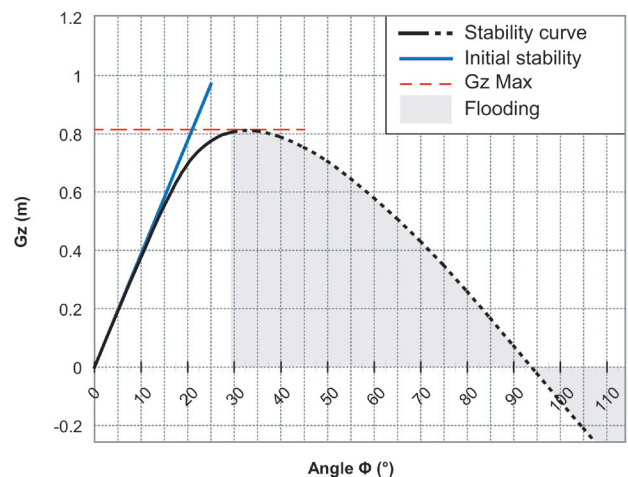


Fig. 46.6. Drawing: Author.

Considering our restitution and the hydrostatic analysis, it is clear that the *Dramont E* ship, presenting a very low centre of gravity and a wide beam, proves to get a very good transversal stability.

### Conclusion

The present paper is submitted when my research was half way through. The results presented here correspond to only one hypothesis of reconstruction. In my opinion, some characteristics of the present reconstruction of the *Dramont E* do not have to be questioned again. Indeed, the length-over-all and the maximal beam, directly inherited from the archaeological remains, are a permanent definite basis. The most controversial points, like the importance of the freeboard and the presence of a second layer of amphoras, can still be reconsidered.

Indeed, the hydrostatic analysis demonstrates that even if the righting arm in loading condition is very large, only few degrees of heeling are sufficient to get the sheer line at the water level. We are tempted to analyse this result as the proof of a freeboard which is too low: consequently it should be conceivable to raise the sheer line, adding the equivalent height of a supplementary wale. Such hypothesis would, as a consequence, increase the volume of the hold which could accommodate appropriately a second layer of amphoras. The hydrostatics conditions would be greatly modified and, consequently, a new analysis may demonstrate the better seaworthiness of such a configuration.

However, the hypothesis of reconstruction presented in this paper remains as a reasonable archaeological and naval solution, which corresponds to a radical solution of design for a commercial ship, despite displaying an extremely seaworthy ship.

### Notes

- 1 It is difficult to establish exactly the extent of this continuous plundering. Photos and testimony of the site in its original configuration are too scarce to evaluate the number neither the place nor the nature of the artefacts pulled out from the wreck. However it is obvious on the few photos dating to the beginning of the excavation in 1981-1982 that the majority of the amphoras are still standing vertically in their original position.
- 2 Different software has been used to complete the three-dimensional model: *Adobe Illustrator* for some of the two-dimensional drawings, most of the work has been realised using *Rhinoceros 3D 4.0*. Regarding the hydrostatic calculation I used *Orca 3D*, a plug-in for *Rhinoceros*, dedicated to naval architecture and naval analysis.

### References

- Basch, L., 1987, *Le musée imaginaire de la marine antique*. Athens.
- Gassend, J.-M., Liou, B. & Ximénès, S., 1984, L'Epave 2 de l'Anse des Laurons (Martigues, Bouches-du-Rhône). *Archaeonautica* 4: 75-105. Paris.
- Gassend, J.-M., 1998, L'apport des découvertes des vestiges antiques du navire des Laurons 2 à la restitution d'une épave antique. In E. Rieth (dir.), *Méditerranée antique : pêche, navigation, commerce. Actes du Congrès National des Sociétés historiques et scientifiques, 120e, Aix-en-Provence 1995, 121e, Nice 1996*, 197-201. Paris.
- Liou, B. & Gassend, J.-M., 1990, L'épave Saint-Gervais 3 à Fos-sur-Mer (milieu du II<sup>e</sup> siècle ap. J.C.). Inscriptions peintes sur amphores de Bétique. Vestiges de coques. *Archaeonautica* 10: 157-264. Paris.
- Parker, A. J., 1992, *Ancient shipwrecks of the Mediterranean and the roman provinces*. Oxford.
- Pomey, P. (dir.), 1997, *La navigation dans l'antiquité*. Aix-en-Provence.
- Pomey, P., 1998, Conception et réalisation des navires dans l'Antiquité méditerranéenne. In E. Rieth (dir.), "Concevoir et construire les navires. De la trière au picoteux", *Technologie, Idéologies, Pratique, Revue d'anthropologie des connaissances* XIII.1: 49-72. Ramonville Saint-Agne.
- Pomey, P., 2003, Reconstruction of Marseilles 6th century BC Greek ships. In C. Beltrame (ed.), *Boats, Ships and Shipyards. Proceedings of the Eleventh International Symposium on Boat and Ship Archaeology, Venice 2000*, 57-65. Oxford.
- Pomey, P., Rieth E., 2005, *L'archéologie navale*. Paris.
- Roman, R., 1997, *Etude architecturale comparative de sept navires de commerce gréco-romains et byzantins*. Unpublished Ph.D. dissertation. Université de Provence. Aix-en-Provence.
- Santamaria, C., 1995, L'épave DRAMONT 'E' à Saint-Raphaël (V<sup>e</sup> siècle ap. J.-C.). *Archaeonautica* 13. Paris.