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GIS to catalogue the shipment of *naves lapidariae* in Mediterranean Sea

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***Abstract* – In this study we are going to list and catalogue *ancient marbles* from the sea bottom along the Mediterranean Coast and we discuss the localization and the morphological features of the original quarries that are situated above all in Greece, Asia Minor, and in Egypt. Finally we are going to expose the implementation of data in a GIS.**

I. INTRODUCTION

In the imperial period, between the 2nd and the 3rd century a.C., many rich buyers turned to famous oriental shops for the order of some decorated sarcophagus, sculptures and precious marble reliefs.

The most important centers were in Grece, in Attica, in Asia Minor, at Afrodisia and at Efeso, where expert artisans used to work under the supervision of imperial officials, in factories near the quarries.

The shipment was by *naves lapidariae* that took on board columns, capitals, finished architectural decorations, some of those were unfinished works or they had just been rough-hewn, to be finished in the places, where they were taken, by traveling workers or local stonecutter.

There are many wrecks with a stone shipment *(naves lapidariae)* along sea coast of the Mediterranean Sea.

In this study we are going to list and catalogue ancient marbles from the sea bottom along the Mediterranean Coast and we discuss the localization and the morphological features of the original quarries that are situated above all in Greece, Asia Minor, and in Egypt. Finally we are going to expose the implementation of data in a GIS.

II. THE SHIPMENT OF *NAVES LAPIDARIAE*

The use of marbles, already common in late republican age, became more diffused in imperial age. At the beginning of this trend, if we can define it in this way, the use of imported ancient marbles was devoted to the public buildings or to the rich senatorial villas in particular. With the development of the Empire, the use of marbles caught on more and more and marble became important for funerary buildings. Even after the Luni quarries (Carrara white marble) opening, the best provisions source in imperial age were Greece (for ancient white marbles), Asia Minor, Egypt and Tunisia (for coloured marbles and granites). For example from Greece Pario marble arrived (from Paros), Hymettus and Pentelic (the quarries were near Athens), Cipollino or Carystus Caristo (from Eubea). In Asia Minor, in Phrigia in particular, Pavonazzetto was pulled out; in Tunisia instead there were the "giallo antico" (ancient yellow) or Numidian marble. In conclusion, we have to remember that Egypt supplied the granite for roman Obelisks, the red porphyry (for Emperors sarcophagi) and finally alabasters. The increase of marble using created a statio marmorum or marbles department that received and provided marbles. These marbles came from several empire and were employed for very different uses: the building and the restoration of public monuments, to adorn regal palaces and to be sold to privates. The intensity and the importance of this type of commerce is also documented by a lot of documentary materials about many shipwrecks of naves lapidariae (ships that carried out stones) along Mediterranean Coast places, in addition to Greek coast, like the coast of Calabria, Sicily and Apulia (figures 1,2,3,4). The stones ships reached especially Ostia, where the shipment was placed on big boats that sailed the Tiber up to Rome.

Fig. 1 – Italy, San Pietro in Bevagna wreck (Apulia): Greek marble sarcophagi.

Fig. 2 – Italy, Torre Chianca wreck (Apulia): n. 5 Cipollino (Karistos, Grecia) marble columns.

Fig. 3 – Italy, Naxos Gardens wreck (Sicily): marble block on seabed (ph. by Tania Marchesini).

Fig. 4 – Italy, Capo Taormina wreck (Sicily): columns at 24 meters depth (ph. by Tania Marchesini).

III. THE STRUCTURE OF GIS

The most interesting element of the data model in a GIS is the database (Table 1). Generally cartography is principally necessary to produce maps for the representation of information; but a GIS has the data analysis as main purpose, to become a support instrument for decisions.

In a GIS analysis we do not get a simple geometric representation of artifacts and objects: rather we point to the direct relationships among different elements, like connection, vicinity or inclusion.

By these relationships the GIS allows us - with a structure of data that are different but complete – to define complex monitoring analysis of the interested area, with a definition of specific features of the *topos.*

Essentially, data model, in an interaction perspective, establish the input of descriptive data of every single real object, that we can define area attributes.

This set of information (geometry, topology, attributes) are then implemented in a GIS by a physical model, that now is based on data structure of relational nature, that are characteristic of more advanced *database* and on *hardware* e *software* architectures that are in *client/server* mode, in local nets of calculators: in our case, GIS software that has been used for implementation is a QGIS software.

Usually, the essential steps of creating a geographic data elaboration are: data input, data management, data analysis, data presentation.

However we need to distinguish data types; they can be divided into two categories: spatial data (that is the placement of geographic elements, in our case the archaeological site along the Mediterranean Coasts) and attributes data (in this case the classification of the site of *naves lapidariae* wrecks, the name of ancient marbles, marble quarries, the amount of marble, etc.), that are associated to spatial data (figure 5).

The spatial data (maps, surveys, etc.) have been implemented by manual digitalization, *scanning* and *graphic files* in vectorial format; but the attributes data have been input by *script* with a computer keyboard (figures 6,7).

N.	PLACE	ARCHAEOLOGICAL ARTIFACT	ANCIENT MARBLE	DIMENSIONS
1	Porto Nuovo (Corsica)	4 shaft sections; 5 blocks	Marmo Lunense	Diameter =1,5 m. thickness = 1 m.; width 1,9 -2,5 m. lenght 1,9 -5,8 m.
2	Giardini Naxos (Sicily)	13 blocks 23 columns shafts	Cipollino	1x3,3x0,6 m. 0,4-0,8 m. diameter , lenght 6 m.
3	Punta Scifo (Calabria)	6 monolitic basins 2 blocks 1 blocks	Pavonazzetto Proconnesio White Frigio	2 width 1,02 m. 1 width 1,7 m. 1 width 2,10 m. 2 width 2,37 m. 5 fragments 2,10 m. 4 basins 1,02 m. 4 supports height 0,6 m. 5 bases height 0,42 and width 1 m. 2 sections height 4,74 m. 3 sections height 5,85 m. 1 shaft height 5,82 m. Lenght 3,12 m. Lenght 3,12 m.
4	Capo Granitola 1 (Sicily)	49 blocks	Proconnesio	Lenght from 0,5 m. to 5 m.
5	Capo Granitola 2 (Sicily)	3 corinthian capitals	White marble	
6	Camarina (Sicily)	2 columns	Ancient Yellow (Giallo antico)	
7	Capo Taormina (Sicily)	2 blocks	Cipollino	
8	Isola delle Correnti (Sicily)	6 Blocks 10 blocks 5 blocks 7 blocks 5 blocks 6 blocks 2 blocks	Proconnesio	Height 0,55 m. Height 0,70 m. Height 0,80 m. Height 0,95 m. Height 1,20 m. Height 1,40 m. Height 1,75 m.
9	Marzamemi 1 (Sicily)	3 blocks 5 blocks 2 blocks	White gray marble	Height 0,50 m. Height 1,00 m. Height 1,30 m.
10	Marzamemi 2 (Sicily)	Architectonic elements 1 slab	Proconnesio Ancient green (Verde antico)	
11	Capo Cimiti (Calabria)	2 shafts 4 shafts	Green Cipollino	lenght 6 m., diameter 0,9 m. Lenght 8,5 m., diameter 0,9 m.
12	Torre Sgarrata (Apulia)	18 sarcophagus	Taso Marble	
13	San Pietro in Bevagna (Apulia)	23 sarcophagus	Marmo di Taso	
14	Ladispoli (Lazio)	Three lines of columns	Marble	

		shafts		
15	Dramont (France)	3 blocks	African Marble	3,8 x 0,95 x 0,8 m. 2,68 x 1,1 x 1,45 m. 2,2 x 1 x 1 m.
16	Saint-Tropez (France)	12 marble elements (column drums, bases, lastre e architrave)	Marmo Lunense	
17	Isola di Sapientza (Greece)	Slabs, Columns	White marble Granite	
18	Methone 1 (Greece)	4 sarcophagus	Marble from Assos in Troade	
19	Methone 2 (Greece)	20 shafts	Egyptian Granite	
20	Sile (Turkey)	shafts 1 block 5 capitals 1 column base 2 blocks 1 slab 1 statue 1 feminine bust 1 Sarcophagus top	Ancient green (Verde antico) Proconnesio	height 4,5 m.
21	Sidi Ahmad port (Libya)	2 columns blocks	Pentelico	

Table 1. - The database fields of GIS.

	idCava	nome	nomeromano	nazione	comune	marmo
0	1	Marmo di Carrara	Marmor lunense	Italia	Carrara	Lapis lunensis
1	2	Africano	Marmor luculleum	Turchia	Teos	Africano
2	3	Rosso antico	Marmor taenarium	Grecia	Capo Matapan	Rosso antico
3	4	Giallo antico	Marmor numidicum	Tunisia	Chemtou	Giallo antico
4	5	Cipollino	Marmor caristium	Grecia	Karystos	Cipollino
5	6	Marmo di Procon...	Marmor proconn...	Turchia	Isola di Marmara	Marmo Cipolla
6	7	Pavonazzetto	Marmor phrygium...	Turchia	Iscehisar	Pavonazzetto
7	8	Verde antico	Marmor thessalic...	Grecia	Tassaglia	Verde antico

Fig. 5 – Attributes Tab.

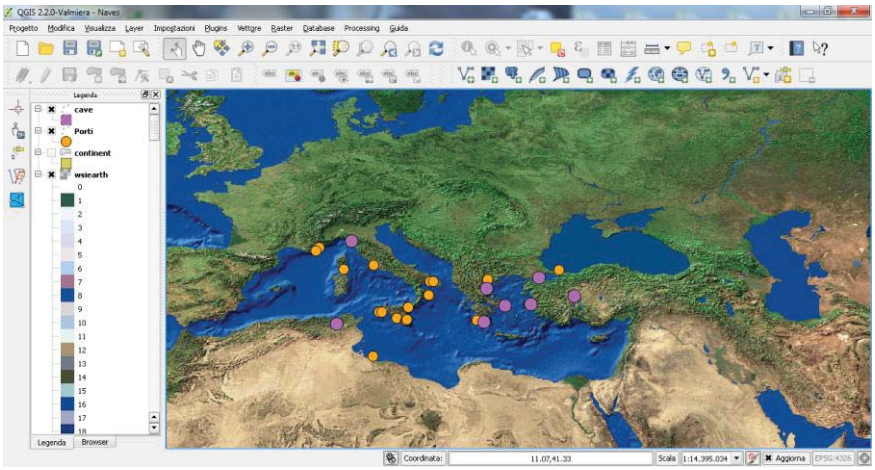

Fig. 6 – GIS, a work session screen: wrecks with yellow circles (archaeological site) and ancient marble quarries with purple circles.

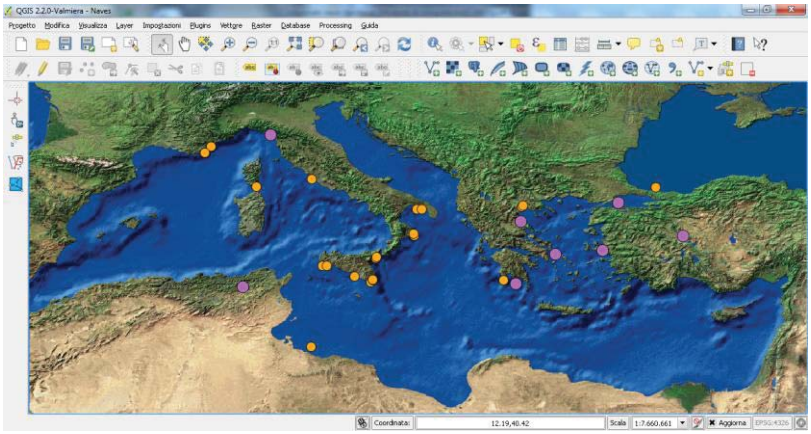

Fig. 7 – GIS, a work session screen.

IV. CONCLUSIONS

Analysis instrument, that is always updated and has simplicity of reading and interpretation, is composed of computer documents, that are pointed not only to the scientific study, but also to every institutional request, to promote ventures for recovering, materially and economically, the archaeological heritage that is along Mediterranean Coasts.

Soon it stands out that the massive presence in the ships' wrecks of proconneso marble, that is a white marble with gray stripes from marmara isle in turkey, which was loved a lot by romans marble workers, because of its low cost on market, as we can see on edict of maximum prices by Diocleziano.

Therefore this study contains development starting points for a territorial improvement and the planning of a marble heritage recovering systematic program for an upgrading of a wider interested territory area.

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