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Islands of the Middle Sea: An Archaeology of a Coastline

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Introduction

The paper presented here is part of a broader research project aimed at establishing the maritime role of the Maltese Islands during the Roman and Medieval periods. Initially, the original research agenda did not entail any environmental sampling. However as the various sources, including archaeological and historical were being reviewed it became apparent that in order to achieve the various objectives that were set environmental reconstruction would prove to be indispensable.

The ANSER project provides the ideal platform for the presentation, discussion and preliminary review of data gathered and analysed. Primarily, because the first of the planned seminars deals specifically with past environments that existed within ancient ports and harbours. Secondly, because the ANSER seminars provide an excellent cross-section of research and work that is going on in the western Mediterranean.

At this early stage it would be opportune to highlight a few general reasons as to why some archaeologists attempt to reconstruct past environments. Brown cites two important factors: a) the influence of the environment on human activity and b) the impact of past peoples on their landscape. He states that «it is the manipulation of natural resources that changes human environments and creates landscapes». Alongside land, plants, animals, soils and minerals Brown also lists water as an im-

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portant resource.[1] In this context water is probably listed as a resource for drinking, irrigation and fishing but one cannot exclude that access to navigable water can be considered an asset.

It was deemed necessary to establish the ancient coastline because the harbours and anchorages of the Maltese Islands have been and continue to be considered as one of their prime assets. In ancient times, writers such as *Diodorus Siculus*[2], referred to the excellent harbours of both Malta and Gozo. He also described the commercial benefits that originated from maritime activity and that were reaped by the islands' inhabitants. If any significant changes in the coastline could be proved this would help determine the exact nature of these 'assets' as well as how Malta's inhabitants exploited these in the past. Significant changes in the coastline could also lead to a reinterpretation of various archaeological sites that are situated in the surrounding landscape. The association between such sites and the sea can only be fully understood if a realistic spatial dimension is defined. Finally, just as exposure to winds and sunlight determine the habitability of caves[3], likewise, aspects such as topography and geographical orientation are essential to understanding the suitability of harbours.

The first mention of silted harbours in Malta contained in an academic publication is that by Scicluna, an amateur diver and antiquarian, through his map published in 1965.[4] Scicluna highlights five silted harbours: Mellieha, St. Paul's Bay, Salina, Marsa and Marsascala. Scicluna's ideas were based solely on topographic observations and not on any scientific studies. The absence of such studies prevented the identification of the nature of the marine environment that existed within the ancient harbours. Despite such shortcomings, Scicluna provided the initial, and vital indication, for future research.

The investigation of the silted harbours of Malta must also be considered as the first step towards a better understanding of the evolving maritime role of these areas and how this role has changed due to variations in topography. If the bays did change then it is imperative to understand the impact of these changes on the local population as well as maritime activity in the area. To determine the causes of siltation of the harbours I shall be looking at cultural as well as natural factors that may have contributed to this phenomenon. Given that this study transcends various periods of the islands' history enables the observation of various phenomena (such as site migration) through time.

Scicluna missed out other silted ports such as those at Msida, Pieta', Mistra and Gzira (fig. 1). This could be due to the fact that some of these areas have, over the past two centuries, been heavily urbanised and topographic changes are not immediately noticeable. The main focus of this study falls on three areas, Burmarrad, Marsa and

1. A.G. Brown, *Geomorphological techniques in Mediterranean landscape archaeology*, in P. Leveau, F. Trement, K. Walsh, G. Barker (edd.), *Environmental Reconstruction in Mediterranean Landscape Archaeology*, Oxford 1999, pp. 45-54.
2. Diodorus of Sicily, C.H. Oldfather (trans.), London 1952, p. 129.
3. C. Renfrew, P. Bahn, *Archaeology: Theories, Methods and Practice*, 3rd edition, London 2000, p. 256.
4. Missione Archaeologica Italiana (Malta) 1965.

Marsascala. The main reason behind the choice of these three sites is that one may consider them, on the basis of size, location and topography, more than simple open bays. If coastal changes can be proved, the layout and size of these three harbours would change drastically, effecting factors such as the number of vessels able to call into them as well as the quality of shelter offered. Most of the openings of Malta's harbours face nort-heast and although sheltered from the prevailing north-westerly winds most of these harbours and havens are vulnerable to the grigal, the notorious northeasterly storm which threatens the islands between the months of December and February. It therefore follows that all-weather anchorages had to be sheltered from this threat. Today one can observe that none of the harbours enjoy full protection from the grigal. Therefore, the reconstruction of the ancient coastline within these harbours will help define whether vessels would have been protected over the winter period.

Another reason for the singling out of specific sites is the degree of urban development. As has been mentioned above, the present-day urban landscape makes it difficult, indeed impossible to carry out any fieldwork in certain places. In the areas chosen, especially Burmarrad, the 'natural' environment is somewhat still intact thus facilitating research and fieldwork.

1. Coastal Changes

There exist various agents of coastal change in the Maltese Islands. These include land subsidence, siltation and coastal erosion by the forces of the sea. Due to major plate tectonics in the central Mediterranean region, the island of Malta is rising from the south and subsiding on the north coast.[5] Evidence for, as well as the calculation of, a rate for this subsidence has recently been proposed. The method used for this exercise largely involved the use of archaeological sites in Birzebbuga Bay for the measurement of sea level change.[6] Coastal erosion is caused by a variety of factors including the above-mentioned tectonic movements, wave action and rainwater run-offs. Areas where the underlying deposits of clay are exposed are more susceptible to land subsidence. This is particularly true for areas that have clay close to or at sea level such as in the north west of Malta.[7]

Siltation is, as mentioned above, another major factor that contributes to coastal changes in Malta. Archaeologist David Trump, recently described the deposition of soil to the plains as one of the three major surface changes to have happened in Malta.[8] It can be said that the study of these depositions has remained one of the least researched aspects of the island's past. In a publication on the river valleys, (widien

5. M. Pedley, M. Hughes Clarke, P. Galea, *Limestone Isles in a Crystal Sea: The Geology of the Maltese Islands*, Malta 2002, pp. 94, 31.

6. R. Abela, J. Schembri, *Relative Sea Level Change in Malta: A site-specific enquiry paper read at the first Mediterranean Maritime History Network*, Malta 2002 (forthcoming).

7. M. Pedley, M. Hughes Clarke, P. Galea: *op. cit.* see note 5, p. 83.

8. D. Trump, *Malta: Prehistory and Temples*, Malta 2002, p. 14.

in Maltese from wadi in Arabic) of Malta minimal space is dedicated to the plains that drain the various widien throughout the islands with the main focuses being on the 'rivers' themselves and on the flora.[9] Likewise, the recent publication on the geology of the Maltese Islands dedicates no more than a few lines to the phenomenon of sediment movement and alluvial fans.[10] It is surprising how such a feature, important as it is for a variety of reasons such as agriculture, coastal dynamics and hydrology, has not been given its due importance.

2. Siltation in the Mediterranean

The occurrence of alluvial deposition and subsequent silting up of coastal areas has been widespread throughout the Mediterranean. Some of the most telling evidence for coastal change and extension in the Graeco-Roman Mediterranean can be gleaned from famous cities such as Ephesos and Miletos, that were either left landlocked or displaced «their ports to retain links to the sea».[11] Evidence for this form of environmental change is in no way limited to antiquity. For example, due to the silting up of the Arno in the Fifteenth century, Pisa was no longer accessible to seagoing ships and had to make use of another harbour, which was to the south of the Arno mouth.[12]

Considering the extreme and far-reaching transformations brought about by the occurrence of coastal change it comes as no surprise that ancient writers noted such phenomena. Herodotus, writing in the Fifth century B.C., concluded «that the Nile valley and delta were another case of a great inlet of the sea which had been filled with the silts deposited by successive floods».[13] Ancient writers also commented on the causes of such changes and searched for explanations in human interaction with the landscape. Writing in the Second century A.D., Pausinias attributed the interruption of alluvial deposits at the mouth of the Achelous river to the expulsion of the Aetolians and subsequent abandonment of the land forming the catchment areas of the river. What is important here is not whether Pausinias was correct in his interpretation but rather his early realisation of the existence of interaction between humans and the landscape. Later writers continued to propound the belief that land erosion and subsequent siltation were mainly due to anthropogenic causes. Giuseppe Paulini, writing in 1608, claimed that the lagoon of Venice was in danger of silting up due to deforestation in the Alps.[14]

In recent times, it was the scholar Claudio Vita-Finzi, through his book "The Mediterranean Valleys" that inspired recent research into the history and nature of sedimentation in the Mediterranean.[15] The main thrust of his study focused on the

9. S. Haslam, J. Borg, *The River Valleys of the Maltese Islands: Environment and Human Impact*, Malta 1998.
10. M. Pedley, M. Hughes Clarke, P. Galea, *op. cit.* see note 7, p. 95.
11. J. Bintliff, *Time, process and catastrophism in the study of Mediterranean alluvial history: a review*, in *World Archaeology* 33.3, 2002, pp. 417-435.
12. N.J.G. Pounds, *An Economic History of Medieval Europe*, London - New York 1994, p. 372.
13. P. Horden, N. Purcell, *The Corrupting Sea: A Study of Mediterranean History*, Oxford 2000, p. 312.
14. A.T. Grove, O. Rackham, *The Nature of Mediterranean Europe: An Ecological History*, New Haven - London 2001, p. 290.
15. P. Horden, N. Purcell, *op. cit.* see note 13, p. 316.

division of alluvial deposition into two phases that he named the 'older and younger fills'. The older valley fill ended between 8000 and 7000 B.C. whereas the younger fill can be traced to between 500 and 1500 A.D. [16] His research started in Tripolitania and was expanded upon after visits to valleys in Italy and Spain.[17] Vita-Finzi proposed that the timescale of the younger fill found in the various valleys throughout the Mediterranean was 'synchronous'. It therefore followed that humans could not have been responsible for this universal occurrence, thus «the only possible explanation remaining was a general change in the climate, which he [Vita-Finzi] took as the most likely explanation for the Older fill too».[18] Just as Pausinias and Paulini had attributed siltation to human activity, Vita-Finzi proposed that climate was the all-important agent of change with regards to land erosion and sediment deposition.

Both Horden and Purcell and Grove and Rackham dedicate extensive discussions on the relationship of alluvial deposits and siltation with history.[19] Horden and Purcell criticise Vita-Finzi's original hypothesis on the grounds that research has shown that humans, as in the hinterland of Carthage, did play a role in land erosion and subsequent alluvial deposits.[20] Recent studies in the south of France have focused on the silting of harbours such as Marseille where it was «found that factors determining the evolution of the shoreline were directly connected with the history of human settlement and urbanization from the initial bronze age village to Greek and Roman urban development».[21]

Horden and Purcell highlight the fact that Vita-Finzi's theory opened up a debate that is of 'continuing importance'. There are two main reasons why sediments should be studied: a) to enquire about the effect of these deposits on the economy and society of the locality and b) to investigate the causes of deposition. In the case of the latter, should human activity prove to be the cause it is, if possible, essential to try and establish the nature of this activity.[22] Despite their move away from the climatic determinism and highlighting the significance of human activity in alluvial and siltation processes, Horden and Purcell accept that 'the extreme form of anthropogene determinism appears implausible' because «the erosion of the land, the expansion of human agriculture, the post-glacial rise in sea-level, the instability of the deep structures of Mediterranean geology [...] interact cumulatively».[23]

Whilst yielding that humans could influence erosion, Grove and Rackham play down the effect of human activity on the overall process. They cite examples of alluviations that occurred at periods of 'little human activity' and others that continued

16. C. Vita-Finzi, *The Mediterranean Valleys: Geological Changes in Historical Times*, Cambridge 1969, pp. 92; 100; 116; 120.

17. A.T. Grove, O. Rackham *op. cit.* see note 14, pp. 290-91.

18. P. Horden, N. Purcell, *op. cit.* see note 13, p. 316.

19. P. Horden, N. Purcell, *op. cit.* see note 13, pp. 298-341, A.T. Grove, O. Rackham, *op. cit.* see note 14, pp. 288-311; 328-350.

20. P. Horden, N. Purcell, *op. cit.* see note 13, p. 319.

21. C. Morhange, C. Vella, M. Provonsal, A. Hesnard, J. Laborel, *Human impact and natural characteristics of the ancient ports of Marseilles and Fos, Provence, southern France*, in P. Leveau, F. Trement, K. Walsh, Barker, G. (edd.), *Environmental Reconstruction in Mediterranean Landscape Archaeology*, Oxford 1999, pp. 145-154.

22. *Ibid.*, p. 320.

23. *Ibid.*, p. 327.

despite phases of increased and decreased human activity. In their view «the weight is against human activity as the principal cause, and towards an explanation in terms of weather [and] it is difficult to resist the conclusion that the primary cause was climate or weather».[24] Although similar to Vita-Finzi's original proposal, Grove and Rackham offer an alternative explanation with regards to patterns in time and space. Rather than an all-encompassing deposition of the younger fill within a given timeframe and geographic area[25], Grove and Rackham explore the possibility of local variations. Deluges may differ in frequency and in density whereas local topography is another variable that must be kept in mind: 'soft collapsing Basilicata is very different from hard, cliff-bound Crete'.[26] Both sets of authors agree that it is a combination of factors that cause erosion and subsequent depositions, however the former lean towards human activity and the latter towards climate and the weather.

John Bintliff's recent review of the study of Mediterranean alluvial history contains two important proposals. Firstly, that «instead of having to decide on climate or anthropogenic causation as monocausal alternatives, it would perhaps be wiser to investigate the many ways in which natural and human impacts interact to encourage or inhibit erosion on Greece and the Mediterranean».[27] Secondly, he states that «it also needs to be underlined that the consequences of such alluviation, however stimulated, can be negative, neutral or positive for human settlement and land use».[28]

3. The River Valleys of Malta

The various river valleys discussed in this study evolved into their present outline during the last glacial maximum when the sea level dropped and the watercourses cut deep and precipitous valleys.[29] Phases of low sea level coincided with weather that was 'highly corrosive, being very wet or with low, rock-shattering temperatures' which led to an increase in sediment and rocks being transported, which in turn helped to cut a steep gradient for the valleys.[30] Subsequently, at the end of the last ice age sea levels in the Mediterranean rose until reaching present day levels approximately 7000 years before present.[31] In Malta, this would have resulted in the flooding of newly formed valleys and their tributaries, thus forming fjord-like deepwater inlets. This meant that deltas that were previously laid down during the last glaciation were, after the above-mentioned rise in sea-level, now about 100 metres under the sea.[32] One must consider that the newly formed bays continued as outlets of

24. A.T. Grove, O. Rackham, *op. cit.* see note 14, pp. 307-311.
25. C. Vita-Finzi, *op. cit.* see note 16, p. 101.
26. A.T. Grove, O. Rackham, *op. cit.* see note 14, p. 311.
27. J. Bintliff, *Time, process and catastrophism in the study of Mediterranean alluvial history: a review*, in *World Archaeology* 33.3, pp. 417-35; 420-21.
28. *Ibid.*, p. 428.
29. M. Pedley, M. Hughes Clarke, P. Galea, *op. cit.* see note 10, pp. 89-91.
30. C. Delano Smith, *Western Mediterranean Europe: A Historical Geography of Italy, Spain and Southern France since the Neolithic*, London 1979, p. 319.
31. K. Lambeck, E. Bard, *Sea-level change along the French Mediterranean coast for the past 30.000 years*, in *Earth and Planetary Science Letters* 175, 2000, pp. 203-222.
32. A.T. Grove, O. Rackham, *op. cit.* see note 14, p. 329.
33. *Ibid.*, pp. 328-330.

rainwater for the sections of valleys that were not drowned. Thus, it can be said that the dynamics of alluvial deposition in coastal areas is the result of the formation of new deltas for the newly drowned valleys.

In the near-tideless Mediterranean most of the sediment comes not from coastal erosion, but from inland erosion via rivers and this sediment originates from the catchment areas of the river and its tributaries. A substantial amount of sediment does not reach the sea but is «stored in alluvial fans, floodplains and river terraces». On the Mediterranean mainland, deltas have 'straightened' out the coast, forming beaches to either one side or other of the river mouth. Conversely, on Mediterranean islands, the coastal changes were slower and are often not complete.[33] This is definitely the case in Malta where the storage of the sediments occurs mainly in the alluvial fans and floodplains that in turn form at the head of the bays. One of the main reasons why the floodplains have not extended to the mouth of the bays is the great depth of the original valleys. One tributary feeding the valley of what is today the Grand Harbour measures, at its deepest, just over forty metres from present-day sea level to bedrock.

There exist many river valleys in Malta but, as has already been discussed, three have been selected for detailed study. I shall now give brief descriptions of these valleys, their catchment areas and bays. The place names Marsa and Marsascala are used in the present day for both the coastal area and the bay. Burmarrad, on the other hand, is today the place name used for the hamlet and the floodplain that it overlooks. The bay is today known as Salina due to the Sixteenth century saltpans situated there. However, up until the late Nineteenth century the bay was referred to as both Salina Bay and Bhuarrat[34], the latter being an Anglicised spelling of Binwerrad from which Burmarrad was eventually derived. I have opted to use Burmarrad, as it is more representative of the general area under study.

4. Burmarrad

The Burmarrad floodplain is situated at the head of what is today known as Salina Bay and is fed by four main valleys that in turn are fed by a series of smaller valleys and tributaries. This valley system is the second largest catchment area of fresh water after Marsa (fig. 2). Despite terracing, flash floods still carry significant amounts of runoff as well as cause damage to walls that are specifically built to retain the soil. One such flood in October 1979 deposited over 30cm of sediment on the plain in less than twelve hours.

A map published in the early Sixteenth century portrays this area as marshlands, these were later reclaimed by the Knights of St. John for the construction of a system of saltpans.[35] The storm watercourse was deviated via two channels on either side of the saltpans. These channels were also navigable by small boats but are very

34. M.H. Smyth, *Maltese Islands: Alterations to S.D., HMS Stork*, London 1895, p. 12.

35. E.V. Clarke, M. Agius-Vadalà, *Salt pans in Malta: History, Structure, Operation*, in *The State Veterinary Journal* VI.18, 1957, pp. 8-11.

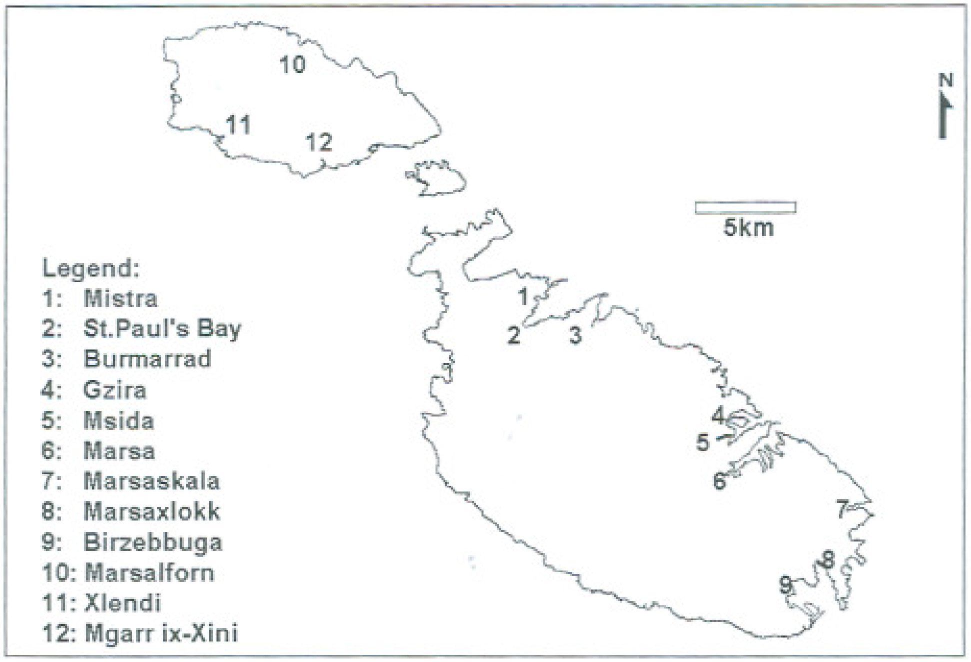

FIG. 1 – Map of Malta and Gozo illustrating the islands' silted harbours.

FIG. 2 – Aerial photo of the Burmarrad plain. (By courtesy of the Malta Environment and Planning Authority).

prone to silting up and are cleaned regularly. In recent times the seabed just outside the saltpans has risen at a relatively rapid rate. The first detailed hydrographic survey carried out in the bay during the early Nineteenth century indicates a depth of 2.7 metres[36] whereas the nautical charts today indicate a depth of 1 metre in the same area thus giving a rate of just under one centimetre rise in seabed per year. Such a rise is mainly due to the interaction between sediment deposits and the growth of the sea grass known as *Posidonia Oceanica*. The latter grows on beds formed by a mixture of shed layers of dead *Posidonia* and sand and/or sediment.[37] That these layers, known as mattes, have accumulated since antiquity is attested by the presence of a Second-century A.D. wreck at Mellieha Bay that was discovered on bedrock and sand under approximately four metres of *Posidonia* mattes.[38]

In the late Middle Ages, Burmarrad was known for the stagnant pools that were present in the area and these are attested by Ghadira (pool) place names. In medieval documents Burmarrad is referred to as both a 'fief and port' that has been placed by scholars south of Salina Bay. Late medieval place name evidence points towards the existence of a port in the area: Hirbit l-Imriekeb (ruins/remains of sailing vessels), Bir l-Imriekeb (well of the sailing vessels) and Habel l-Imriekeb (field of the sailing vessels).[39]

Numerous archaeological sites, ranging in date from the late Neolithic to the Middle Ages are found around the floodplain and these help delineate the potential maximum sea level through time. In conjunction with the topography of the area these sites form a sort of cordon around what was potentially a large lagoon-like bay.

5. Coastal Reconstruction

For Burmarrad, a variety of techniques were used for the reconstruction of the ancient coastline. The main technique used was the retrieval of samples for analysis through coring. Aerial photographs, old maps and documentary sources were then used to complement the information obtained from the environmental samples.

6. Objectives

To date, no scientific studies on the sediments had been carried out on or around the Burmarrad plain. The core samples were taken and analysed with three objectives in mind:

a) to determine whether marine conditions did exist south of the saltpans;

36. W.H. Smyth, *Hydrography of Sicily, Malta and the Adjacent Islands*, London 1823.
37. S.A. Micallef, *A Preliminary Study on the Phenology and Growth Dynamics of Posidonia Oceanica (Linnaeus) Delile Sea-Grass in Malta*, unpublished M.Sc. dissertation submitted to the Department of Biology at the University of Malta 1996 p. 76.
38. H. Frost, *The Mortar Wreck in Mellieha Bay*, London 1969.
39. G. Wettinger, *Place-names of the Maltese Islands ca.1300-1800*, Malta 2000, pp. 35-36.

b) to determine the extent of the ancient bay;

c) to establish dates for the deposition sequence of the alluvium.

7. Methodology

Discussions with local landowners made it clear that the alluvial deposits on the plain are very deep in some areas. Such inaccessible deposits are best sampled by coring[40] and an *Eijkelkamp* manual auger was used to retrieve the first samples (Cores 1 to 8) (fig. 3). However, as it became apparent that the manual auger could not always reach the necessary depths, an industrial drilling rig was used for the remaining cores (9 to 12, 14). Samples were taken approximately every metre except where changes seemed more pronounced. Samples were bagged after being assigned a code number and were subsequently left to slow-dry indoors for seven days. Sample number thirteen was retrieved by kind permission of the landowner from a borehole that was being excavated.

Following the initial results obtained from core three, samples were then taken from the edges of the plain as well as from its centre. This would help establish both the width and the depth of the bay in the past. The choice of sites was also determined by two factors: a) the accessibility of the area for the industrial coring machine and b) by the willingness of the landowner to allow cores to be extracted from his property. Following their retrieval and drying, samples were taken to the laboratory for initial treatment and analysis.

8. Discussion

Initial results obtained so far clearly indicate the presence of a marine environment within the Burmarrad plain. This conclusion has been reached through the examination of the various molluscs present in many of the samples retrieved. The molluscs indicate a dynamic environment that was once predominantly marine but eventually evolved into one that was lacustrine, subsequently becoming dry land (fig. 4). There is also evidence for the formation of saline marshes and/or pools of brackish water. Some of the molluscs present in the samples shed light on the depths of the sea in the bay. The waters in the bay seem not to have been overly shallow but neither too deep. The seawater molluscs found in the samples all live in depths of 12 metres or above. However, for an accurate bathymetric map of the bay through time a more intensive and long-term survey of the floodplain is required.

Besides the molluscs, various other marine sediments were present in some of the core samples. The microscopic analysis of these cores was essential for the interpreta-

40. D.F. Dincauze, *Environmental Archaeology, Principles and Practice*, Cambridge 2000, p. 275.

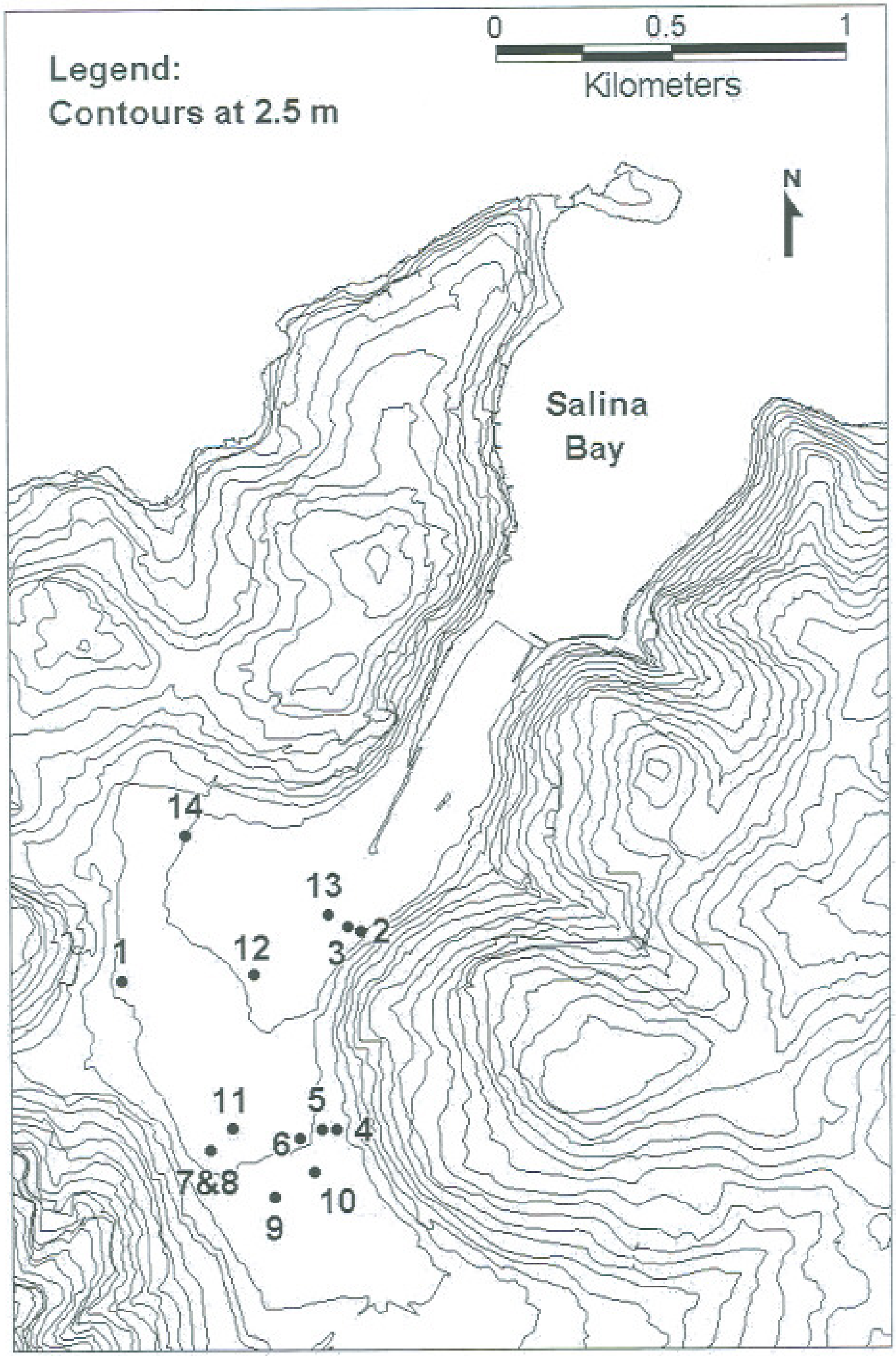

FIG. 3 – Site map indicating the location of cores across the Burmarrad plain.

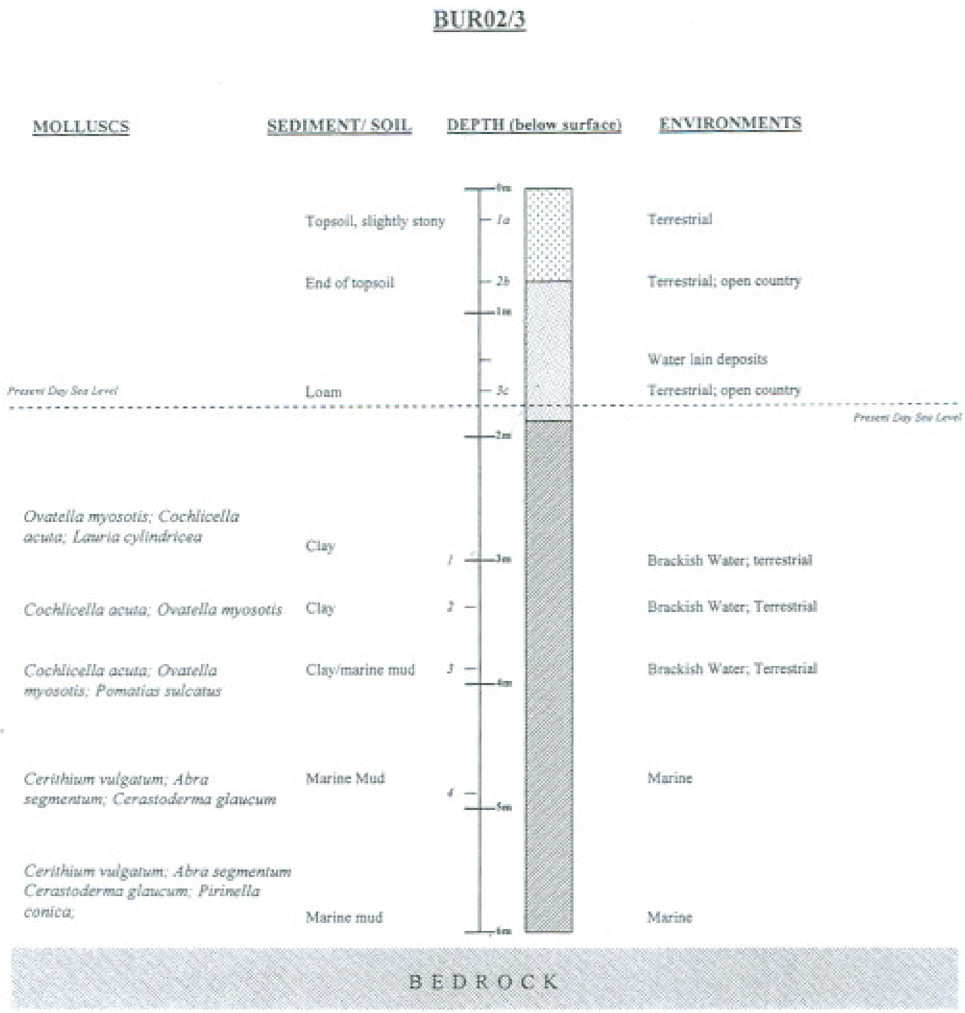

FIG. 4 – Details of core sample from Burmarrad plain.

tion of samples in which molluscs were not present. The type of sediment and microscopic organisms, such as *foraminifera*, found in some of the samples provide secondary evidence supporting the presence of a marine environment in the area. Plant fibres were also present in some of the samples, specifically in zones three and fourteen.

Finally, the index of flattening was calculated for some of the gravel contained within the samples. The resulting calculations give a clear indication of how the gravel was transported as well as distances covered. Initial results show that the gravel contained in the upper levels of the plain was transported there by water and the majority of the samples sediments analysed in the laboratory so far indicate that these are fine sediments.

9. Marsa

The Marsa floodplain is Malta's largest catchment area of fresh water.[41] As the place name suggests it also has a maritime connotation, and today the part of the Marsa that is found at the head of what is today known as the Grand Harbour, over one kilometre from the mouth, is still witness to maritime activity. This area has, over the past centuries, witnessed a vast amount of manmade modifications including land reclamation, dredging and the extension of large quays.[42]

During the Middle Ages ample references can be found describing to the fief of Marsa, a fief that was parcelled out as a royal estate.[43] These references give a clear indication that at least part of the area was suitable for farming. Although early Sixteenth century maps show gardens in the area of the Marsa[44] there are written descriptions of the brackish waters in the area. Such descriptions indicate that the process of siltation was far from complete. In fact, in 1534, the body of Grand Master L'Isle Adam was transported by boat from the chapel of Ta' Ceppuna all the way to Birgu:

«Et il corpo fu nell'aurora della seguente notte portato nella Chiesetta del Giardino della Marsa; e quindi con la barca della Carracca, tutta coperta di panni neri, fu con molte torcie sbarcato alla marina del Borgo.»[45]

Today, this same chapel stands in the middle of the floodplain just under one kilometre from the sea. This event points to the presence of, at the very least, a navigable channel up until historic times. The boat mentioned in the quotation above had a draught of approximately one metre giving an indication of the minimum depth of the channel at the time. Remnants of this channel are still illustrated in

41. E.W. Anderson, *The wied: a representative Mediterranean landform*, in *GeoJournal* 1997, 41.2, p. 113.
42. J. Bonnici, M. Cassar, *The Malta Grand Harbour and its Dockyard*, Malta 1994.
43. S. Fiorini, *Malta in 1530*, in V. Mallia Milanes (ed.), *Hospitaller Malta 1530-1798. Studies on Early Modern Malta and the Order of St. John of Jerusalem*, Malta 1993, pp. 111-198; 143.
44. M. Agius-Vadalà, A. Ganado, *The pre-siege maps of Malta 1536-1563*, in *The Annual Report and Accounts 30th September 1986 of the Investment Finance Bank Limited*, Malta 1996.
45. G. Bosio, *Dell'Istoria della Sacra Religione et Ill. Militia di S. Giovanni Gierosolimitano*, Rome 1630, VII, p. 134.

maps and surveys published in the early part of the Nineteenth century (Smyth 1823).[46] Aerial photographs clearly illustrate the fertile alluvial plain that has now been transformed into a golf course (fig. 5).

Although no coring works were carried out in Marsa some environmental samples were retrieved from a building site in the area (fig. 6). An inspection of the material lifted from boreholes that were excavated for construction purposes revealed marine molluscs as well as cultural material with marine growth and encrustations.

10. Discussion

Data from a variety of sources have been used to attempt an initial reconstruction of ancient coastline around the Marsa. At some stage, the floodplain of today was a large lagoon-like basin deep enough for navigation. Evidence from the analysis of the aforementioned molluscs from the Marsa site indicates depths of water that are at least eight metres and above. The deposition of material into the lagoon would have gradually changed its nature and evolved from one that was predominantly marine to one that was predominantly lacustrine and marshy. A storm water channel would have maintained one or more navigable channels such as that from Ta' Ceppuna to the main harbour.

All the while the newly formed land, very fertile due to its alluvial origin, was brought under cultivation and given out as fiefs by the state. Whereas for the majority of the period discussed the reclamation of the land was a natural process, during the late Eighteenth century Grand Master Pinto reclaimed the remnants of the Marsa marshes to extend the boundaries and increase the revenue of the fief of Marsa. Ironically, this process was to be undone by the British colonial government barely a century later when this same area was re-excavated for the construction of a new harbour![47]

11. Marsascala and other bays

Marsascala Bay lies to the south east of the island of Malta and today serves as a minor port for the fishing community of the town and for recreational craft. So far no environmental sampling has been carried out in the area and studies are based on aerial photographs, topographic observations, place names and parallel evidence from other areas, namely Burmarrad and Marsa.

As can be clearly seen from the aerial photograph (fig. 7), Marsascala is a fertile alluvial plain. Although not as large as Burmarrad and Marsa it is still significant due to the way it snakes inland. The importance of the ancient topography from a maritime point of view is that the inner reaches of the bay offered more protection

46. W.H. Smyth, *op. cit.* see note 36, *passim*.

47. J. Bonnici, M. Cassar, *op. cit.* see note 42, *passim*.

FIG. 9 – Aerial photo of Marsa plain. (By courtesy of the Malta Environment and Planning Authority).

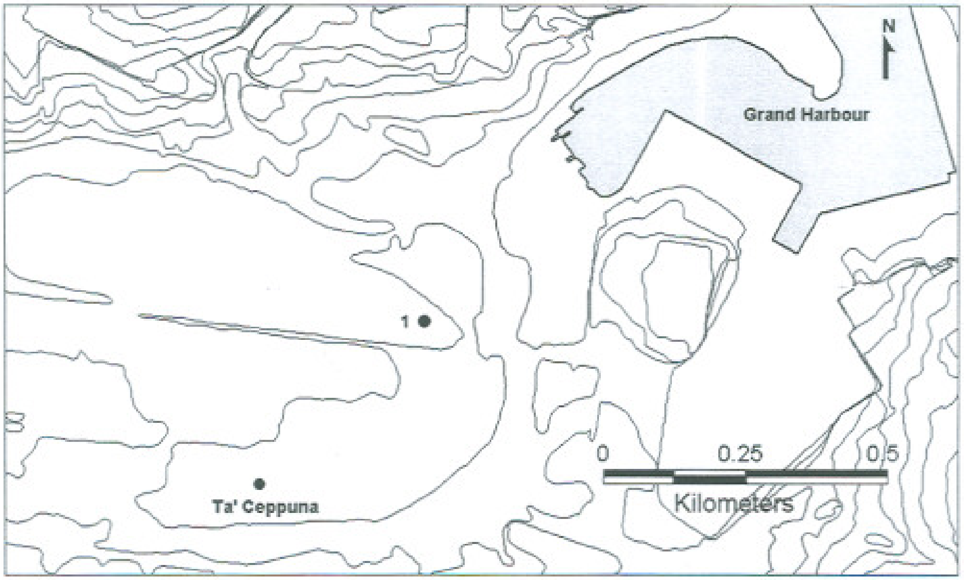

FIG. 6 – Map showing the chapel of Ta' Ceppuna and area one in Marsa.

FIG. 7 – Aerial photo of Marsascala. (By courtesy of the Malta Environment and Planning Authority).

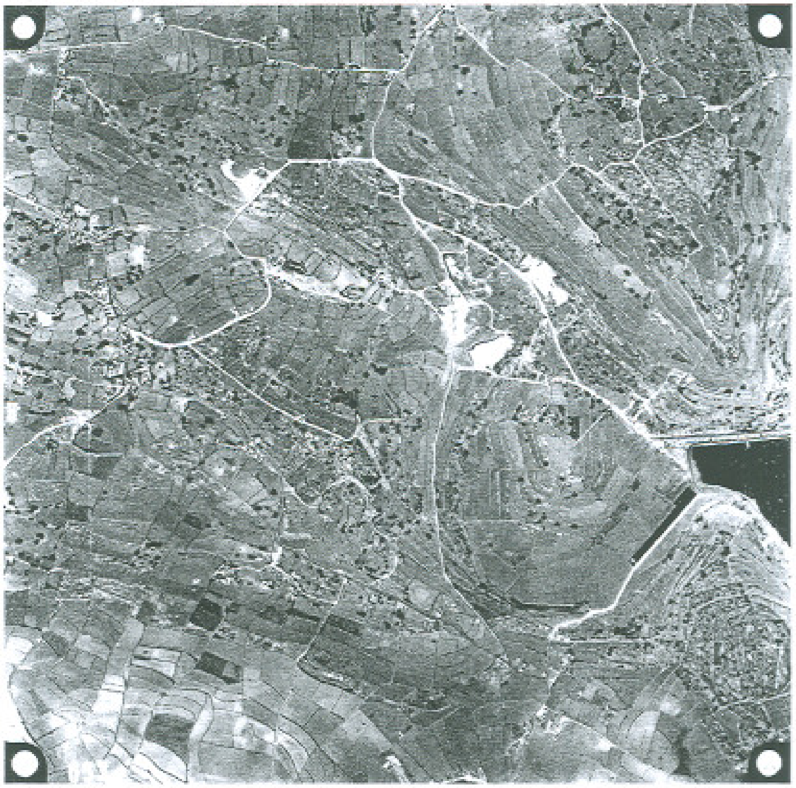

FIG. 8 – Salt marsh at Marsascala.

to vessels than it does today. Place name evidence from the area of Marsascala indicates the presence of stagnant pools in the area up until medieval times. Such place name evidence sheds light on various activities, such as the retting of flax, that were carried out in the area.[48] There still survives a saline marsh in the area that extends in land from the head of the bay. Il-Maghluq tal-Babar is still home to salt-tolerant flora and fauna (fig. 8).

Aerial photography and topographic observations indicate the presence of numerous other silted bays. These include Il-Ballut in Marsaxlokk, Is-Simar at St. Paul's Bay, St. George's Bay in Birzebbugia, Mistra, Msida and Gżira in Malta and Xlendi, Mġarr ix-Xini and Marsalforn in Gozo.

12. Dates

Due to a lack of resources no carbon dating was carried out on the samples retrieved. Tentative dates for the changes in this area can be attempted by using historical and archaeological sources. Written descriptions such as that of L'Isle Adam's funeral give indications of the environment in recent history. An Eighteenth century description of Gozo sheds light on the presence of old mooring bollards far in land and still visible at the time.[49] The presence of various archaeological sites around the plains discussed suggests that these ware built on the periphery of a bay.

Archaeological objects such as those retrieved from the Marsa are mainly from the Roman and Byzantine periods.[50] In Burmarrad, sections in the alluvial deposits contain significant amounts of cultural material, which have been tentatively dated to the Punico-Roman period (fig. 9). Similar sections in the alluvial deposits of Marsascala also contain cultural material although this is yet to be examined. Although deposition of sediments must have begun soon after the formation of the flooded valleys, the presence of datable human made objects within the alluvium suggests the main episodes of deposition happened some time between late antiquity and the late Middle Ages. However, precise dates can only be established accurately through carbon dating.

Research on the possible causes of an increase in sediment deposition are still in their initial phases but the main avenues being followed are those of deforestation, field abandonment and changes in agricultural practices. It is assumed that the island's tree cover was entirely destroyed by the Bronze Age[51] creating, in my opinion, the first phase of instability of the soil. Subsequent changes in agricultural practices, from flax to olives in the Roman period and to cotton in the Islamic period, must also be considered when discussing factors contributing to soil instability. Here, one must also keep in mind a possible period of abandonment that is alluded to in a

48. G. Wettinger, *op. cit.* see note 39, p. 365.
49. G.F. Agius De Soldanis, *Gozo Ancient and Modern, Religious and Profane*, Malta 1746 (Translated by A. Mercieca 2003), p. 53.
50. B. Bruno, N. Cutajar, *Archeologia Bizantina a Malta: Primi Risultati e Prospettive di Indagine*, in M.G. Amadasi, M. Liverani, P. Matthiahe (edd.), *Da Pyrgi a Mozia. Studi sull'archeologia del Mediterraneo in memoria di Antonia Ciasca*, Rome 2002, pp. 109-140.
51. D. Trump, *op. cit.* see note 8, p. 14.

FIG. 9 – Section in alluvial deposits at Burmarrad (scale 50 cm).

medieval Islamic text.[52] Therefore, the main changes in agricultural practices and land use would have taken place after the Roman period. To establish the exact dates and nature of these periods of transition the present study must be expanded to include an archaeology of the surrounding field systems as well as further scientific investigation such as pollen analysis.

The processes or sediment deposition and erosion that have been highlighted through the research presented here are, to varying degrees, part of a wider phenomenon witnessed elsewhere in the western Mediterranean. Other ports went through periods of intense alluvial deposition in the post-classical period. In Sicily, the port at San Leone near Agrigento silted up some time between the end of antiquity and the early Middle Ages.[53] In Italy the region around Pisa and its rivers has been subject to various studies that have shown massive progradation of the land. By the Middle Ages it had become increasingly difficult for vessels to travel and navigate up the Arno.[54] A recent study on the human impact on some ports in southern France cites three periods of substantial erosion of the surrounding landscapes, one of which is «the period of transition from classical antiquity to the medieval period».[55] Finally, research on the Mediterranean coast of Spain, specifically at the Phoenician site of Toscanos, has demonstrated the progradation of the land through time.[56]

Concluding remarks

There are various implications that can be deduced from the results obtained thus far. It would seem that the ports and harbours of ancient Malta were substantially larger than they are today as well as topographically different. These variations in size and shape have a direct bearing on the type of shelter offered to vessels moored or anchored inside. In ancient times, Malta offered several ports and anchorages that were protected throughout the year.

Another consideration worth mentioning is the re-evaluation of various archaeological sites that are found around the plains that are being studied. Once the extent of the harbours and anchorages has been established it is now opportune to revisit certain sites such as olive oil producing villas found in the surrounding landscape. Their location svongly suggests an essential relationship between production and transport.

Archaeological and other evidence from the Maltese Islands points to various phases of demographic movement within the landscape. The silting of bays may have

52. J.M. Brincat, *Malta 870-1054: Al-Himyari's account and linguistic implications*, Malta 1995.
53. R.J.A. Wilson, *Sicily under the Roman Empire: The Archaeology of a Roman Province 36 BC-AD 535*, Warminster 1990, p. 16.
54. M. Pasquinucci, G. Rossetti, *The Harbour Infrastructure at Pisa and Porto Pisano from Ancient Times until the Middle Ages*, in A. Raban (ed.) *The Archaeology of Coastal Changes*, Oxford, *British Archaeological Reports*, i.s. 1988, pp. 137-156, p. 143.
55. C. Morhange, C. Vella, M. Provonsal, A. Hesnard, J. Laborel, *op. cit.* see note 21, p. 146.
56. O. Arteaga, A.D. Schulz, *El puerto fenicio de Toscanos*, in M.E. Aubet (ed.), *Los Fenicios En Malaga*, Malaga 1997, pp. 87-154.

had a significant influence on the inhabitants and their choice of new areas to settle. The combination of these results with other areas of research has the potential to yield some interesting results.

It is the intention of the present author to expand and explore these various aspects in more detail during the forthcoming ANSER seminars.