A report on the magnetometer survey results off the north-eastern coast of Malta 2010-2014: Mellieħa Bay, Salina Bay, and St Paul's Bay

10/10/2021 Full Text

By: Timmy Gambin, Douglas Gossage, Maja Sausmekat

In 2010 a magnetometer survey was conducted off the north-eastern coast of Malta, concentrating on Mellieħa and Salina bays. The aim was to identify potential target anomalies along the shoreline, with areas of interest marked in both bays. Ground-truthing surveys conducted by divers in Mellieħa Bay in

SEARCH …

RECENTLY PUBLISHED

The erosion of Civil Rights

19/Apr 2023: Norwich Castle – POSTPONED to 20/Apr

15/Mar 2023: A late medieval synagogue at Huqoq/Yaquq in Galilee

15/Feb 2023: Climate change and Cultural Heritage: connecting the past, present and future

18/Jan 2023: Breaking (down) Roman pots: investigating pottery found at Tas-Silġ and the Żejtun villa

PRESS RELEASES

The erosion of Civil Rights

Privacy - Terms

2011 and 2012 confirmed the presence of scattered cultural remains, and allowed for the re-identification of the so-called 'Mortar Wreck' site, first excavated by Honor Frost in 1967. A follow-up magnetometer survey was conducted in 2014 within the context of the University of Malta underwater field school, and consequently resulted in the exclusion of Salina Bay for further survey. The 2014 survey concentrated on Mellieħa bay and sought to further positively identify or reject potential anomalies first documented in the 2010 survey. The 2014 survey results revealed the possibility of substantial target anomalies within the bay.

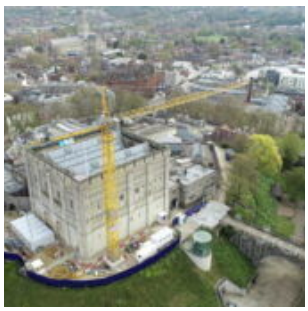
Keywords: shipwreck; Malta; magnetometer survey; Mellieħa Bay; Salina Bay; St Paul's Island

Introduction

Figure 1: Map indicating the locations of 2010 and 2014 magnetometer surveys (source: Google Earth Pro).

The application of magnetometers to the prospection of terrestrial archaeological sites can be traced to the 1950s, and its underwater use was first demonstrated in Turkey in 1965 and successfully applied in 1966 (Green 2014, 436). Magnetometers are used to detect variations in the earth's magnetic field caused by ferrous materials, and over the course of the last half century, have become a prime tool for the detection and mapping of submerged heritage sites (Søreide 2011, 109). Whilst magnetometers are the ideal system for the detection of iron and steel remains, they can detect any ferromagnetic material, including ceramics, and thus, can also be used in the prospection of ancient remains (Green 2004, 62-63). Magnetometers are towed behind a surface vessel, and the intensity of magnetic variations detected will depend on the size, shape, depth of burial and distance to the towed magnetometer system. Thus, the closer the system is towed to the

19/Apr 2023: Norwich Castle – POSTPONED to 20/Apr



15/Mar 2023: A late medieval synagogue at Huqoq/Yaquq in…

15/Feb 2023: Climate change and Cultural Heritage:…

18/Jan 2023: Breaking (down) Roman pots: investigating…

ARCHIVES

Select Month

seabed the better (Søreide 2011, 110; Plets et al. 2013, 26). It is not the aim of this paper to delve into the methodology behind the archaeological uses of magnetometers, but rather to present the data gathered off the north-eastern coast of Malta between 2010 and 2014.

In 2010, a magnetometer survey was conducted in and around Mellieħa and Salina bays (Fig. 1). These initial surveys were concentrated along the shorelines of Mellieħa and Salina Bay, with the intent of identifying potential cultural anomalies on the seabed. The surveys were conducted by the University of Malta, in collaboration with the Superintendence of Cultural Heritage and with the support of the Compass Marine Trust.

The 2010 magnetometer survey covered a total area of 1,322,800 m^2 of seabed, and had the objective of identifying potential shipwreck sites in the shallower coastal waters of the north-east of Malta. Approximately 921,600 m^2 were covered in Mellieħa, and another 401,200 m^2 were surveyed in Salina Bay (Figs 2-3). This general survey was conducted using a lane spacing of 10 m and covered bottom depths of up to 11 m. A number of potential areas of interest were identified in both bays, and a drawback of magnetometers is that it is difficult to interpret gathered data without additional diver surveys in shallow waters and remote operated vehicles (ROVs) in deeper waters (Søreide 2011, 110). In 2011, a ground-truthing survey was carried out by divers in Mellieħa Bay, which confirmed the presence of scattered pottery remains, and in 2012, divers revisited these areas of interest in Mellieħa Bay.

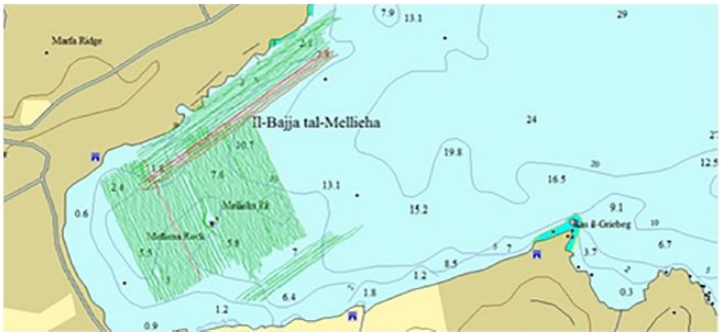


Figure 2: 2010 magnetometer survey conducted in Mellieħa Bay (Gossage 2014, 2).

PLEASE FOLLOW & LIKE US :)

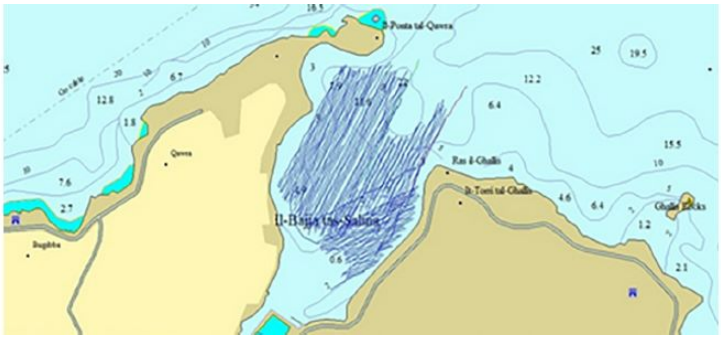


Figure 3: 2010 magnetometer survey conducted in Salina Bay (Gossage 2014, 2).

Cultural remains have been recovered from the seabed of Mellieħa since the late 1950s. In 1959, the first mention of underwater archaeological discoveries in Malta was made in the Museum Annual Reports of the then Museum's Department. The report stated that 'the most important discovery was made in Mellieħa Bay [...] the Fleet Clearance Diving Team, called in to dispose of an unexploded bomb, discovered to be a complete amphora of Graeco-Roman type. With it were found a few other fragments including Campanian blackslipped sherds, a lozenge-shaped tile [...]. The relics seem to represent the wreck of a ship driven ashore in about the second or first century B.C.' (MAR 1959-1960, 3). The archaeological legacy of Mellieħa Bay continued in 1964 when a number of mortaria sherds were recovered, providing further evidence for the presence of a shipwreck (Gambin et al 2021, 3). In 1965, an investigation of 'a Roman shipwreck lying under a mound of dead marine vegetation in the middle of Mellieħa Bay' (Żammit 1965, 4) was initiated by the Mediterranean Underwater Research Unit. In 1967, Honor Frost set out to survey and investigate the site, and the recovered finds were dated to the third century AD. (Frost 1969, 29). The potential for further investigation was the main driver behind the 2012 diver survey, aimed at relocating the site initially investigated by Frost, and determining whether any significant changes had occurred to the archaeological remains since Frost's excavation. The diver survey revealed that the site was intact and material remains were still visible. An archaeological field school was subsequently organised by the University of Malta and the Honor Frost Foundation in 2013 and 2014, which included a further magnetometer survey in 2014.

Salina Bay was not included in the 2014 magnetometer survey. The determining factor for its exclusion was the organisation of the archaeological field school in Mellieħa, and the decision to concentrate efforts there. Nevertheless, the data compiled in the 2010 survey also revealed a number of areas of interest in Salina Bay. The legacy of archaeological discoveries in the bay stretches back to the early 1960s, as documented in the Museum Annual

Reports for 1959-1965 (Żammit 1595, 3; 1960, 4; 1961, 7; 1964, 7; 1965, 4-5). Objects recovered from an underwater context during this period include possible Roman and Medieval pottery sherds and a Roman corngrinder amongst other things (Żammit 159, 1690 & 1964). The presence and recovery of cultural remains in Salina Bay spurred the organisation of an archaeological investigation, initiated by the University of Malta in 2019. The site of this investigation was, however, not influenced by the 2010 magnetometer results, but is based on a location provided by a diver's report. The remains uncovered so far span approximately 500 years and include remains from the Roman, Byzantine and Arab periods. Therefore, whilst a repeat magnetometer survey was not conducted in Salina, important archaeological discoveries continue to be made, and plans are also in place to conduct a ground-truthing survey in the areas of interest marked in the 2010 survey of Salina.

A number of exploratory survey areas around St Paul's Bay were also planned for 2014, however, these were not carried out due to delays caused by equipment malfunction. Later visual surveys of the coastline carried out from a vessel determined that the presence of a number of large fish farms would have severely restricted any survey attempts.

Equipment

The magnetometer that was used for the surveys was a Geometrics Cesium vapor model G882, with depth and altitude sensors included, a 30-metre tow cable and a deck control box with an AC power cable. The condition of the magnetometer hardware allowed only a nose-tow configuration. This limited the ability to carry out surveys as close to the shoreline as preferred, since a significant length of tow cable would have to be let out in this configuration in order to achieve the desired tow fish altitude. Moreover, a low speed needed to be kept, resulting in a lack of coverage in some survey areas.

The computer data acquisition software utilised was Chesapeake Technologies Inc. SonarWizMap version 5.03.0013. The magnetometer acquisition and processing were conducted and operated by geophysical survey specialist Douglas Gossage of the Marine Environmental & Research Services Inc. GPS positioning was provided by a 12VDC WAAS enabled GPS system which was integrated into the data acquisition software. This allowed for geo-referenced data to be collected. The magnetometer was supplied with an AC power cable, resulting in the need to acquire an

additional substitute source of power, provided by a 2 KVA generator.

The seabed in both Mellieħa and Salina Bays is characterised by the presence of large Posidonia oceanica mattes that grow over significant sediment deposits. Sub-bottom profiler surveys as well as cores from the ancient port of Burmarrad, located at the head of Salina Bay, confirm the area as a sediment receptacle for the second largest catchment area for freshwater on the Maltese Islands (Marriner et al. 2012). Over the centuries, sediment run-off from the hinterland have infilled the ancient harbour as well as parts of the seabed. Thus, any significant archaeological deposits in these bays would probably be located under layers of Posidonia mattes and sediments. Given that concentrations of ceramics and the presence of ballast heaps can cause distortions of the earth's magnetic field, a magnetometer survey was considered a viable solution to detect potential archaeological deposits buried in the bays (Papatheodorou et al. 2011).

The 2014 Magnetometer survey

In 2014, a further magnetometer survey was conducted in Mellieħa Bay. This formed part of the field school organised by the University of Malta and supported by the Honor Frost Foundation. The objective behind the revisiting of anomalies identified in Mellieħa Bay was to expand on the 2010 survey data and to investigate and gather evidence for the potential presence of further underwater cultural heritage in several other areas of the bay.

Six locations were chosen for this purpose (Fig. 4). An area of approximately 178,650 m^2 was covered, with water depths ranging from 1.8 m to 8.5 m. Details of the data from the six locations, including total survey size, number of navigation lanes, total cumulative range and bearing, amongst others, are presented in Table 1. The lane spacing was 10 m and the average survey sensor altitude was between 2 m and 4 m, depending on seabed features inside the bay (Fig. 5). In order to get the tow fish as close to the seabed as possible adjustments were made in the tow speed, favoured over laying out a greater cable length. An identified limitation here was the high volume of recreational surface activity within the bay itself, often extending into the survey area. Feature descriptions for each of the six locations will be presented below.

	Survey size	No. of navigation lines	Average range (m)	Total linear (m)	Bearings	Speed (kn)	Total survey time
Wall Cross Mag	32,300 m²	17	190.5	3,238.5	325/145	3	1:42:58
Cave Cross Mag	38,150 m²	41	91.2	3,739.2	143/323	3	3:24:24
Hotel Cross Mag (1)	28,875 m²	18	165.2	2,973.6	028/208	3	1:43:05
Hotel Cross Mag (2)	43,175 m²	27	70.7	1,908.9	142/322	3	2:08:37
Mellieha Cross Mag (1)	24,150 m²	23	120	2,760	065/245	3	1:58:03
Haddow's Valley	12,000 m²	7	97.3	681.1	062/242	3	00:42:21
Total	**178,650 m²**	**133**		**15,301.3**			**11:39:28**

Table 1: Details of the six identified survey locations in Mellieħa bay (Adapted from Gossage 2014, 6).

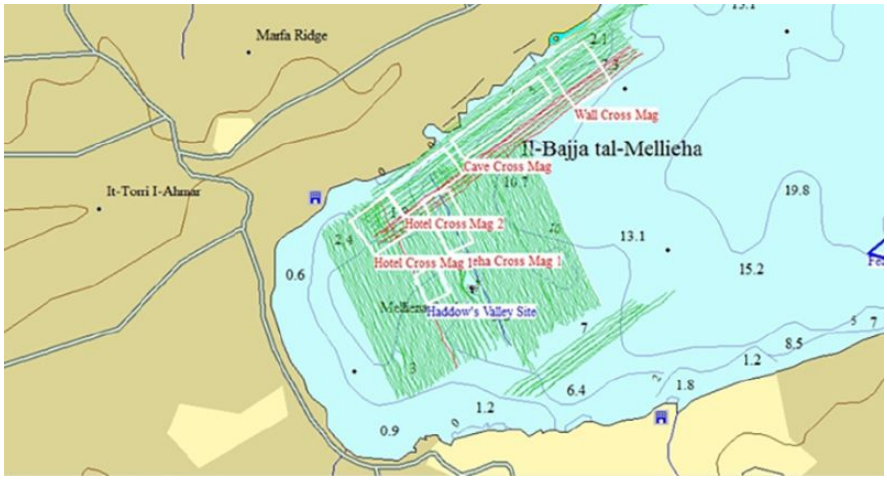


Figure 4: Location map of 2014 survey in Mellieħa Bay (Gossage 2014, 4).

Figure 5: Survey lanes carried out in Mellieħa Bay (Gossage 2014, 8).

Cave Cross Mag

In the 2010 survey, the Cave Cross Mag area had five individual lines of magnetometer data that displayed a long anomalous area in the shoreward-most section of this area. The 2014 survey was unable to better define the area of interest, since perpendicular navigation lines were not possible close to shore. The area has not been released as a potential area of interest, but rather requires further investigation.

Hotel Cross Mag 1

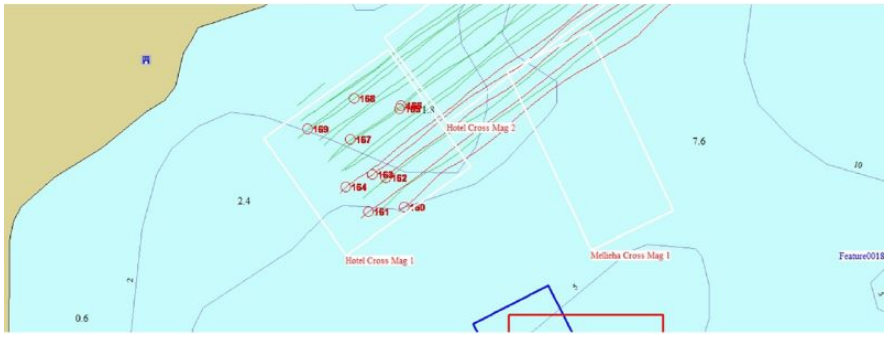


Figure 6: 'Hotel Cross Mag 1' features of interest (Gossage 2014, 11).

This feature area was identified in 2010 as a potential area of interest due to detected magnetic variances near the end of several parallel navigation lines. The presence of magnetic variances at the end of survey lines requires a cautionary optimistic approach to the presence of a true target. However, the 2014 survey provided more evidence in favour of the presence of a true target and valid anomaly area, corroborated through the extension of survey lines over the 2010 area and the continued presence of clear and complete anomalies. The area is spread out and could potentially represent a shipwreck site, warranting further investigation (Fig. 6).

Hotel Cross Mag 2

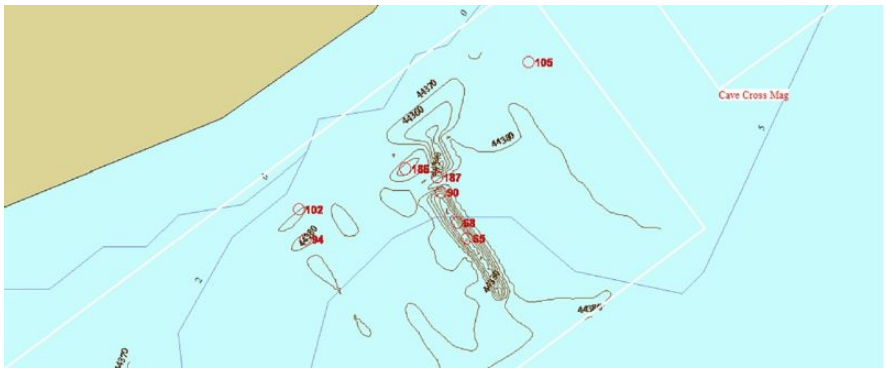


Figure 7: 'Hotel Cross Mag 2' features of interest (Gossage 2014, 13).

The 2014 survey of this area did not produce any further data on the potential location of additional anomalies, and was released from further investigation.

This area was initially surveyed in 2010 and the 2014 survey sought to further define and substantiate the anomalies recorded in the area (Fig. 7). The data gathered points towards an isolated compact target when compared to the spread nature of 'Hotel Cross Mag 1'. The gathered data point towards the presence of an isolated target, rather than an entire wreck site.

Mellieħa Cross Mag 1

The 2014 survey of this area did not produce any further data on the potential location of additional anomalies, and was released from further investigation.

Wall Cross mag

Similar to 'Mellieħa Cross Mag 1', the 2014 survey did not reveal any additional information to the area of interest first identified in 2010. This area was also released from further investigation.

Haddow's Valley site

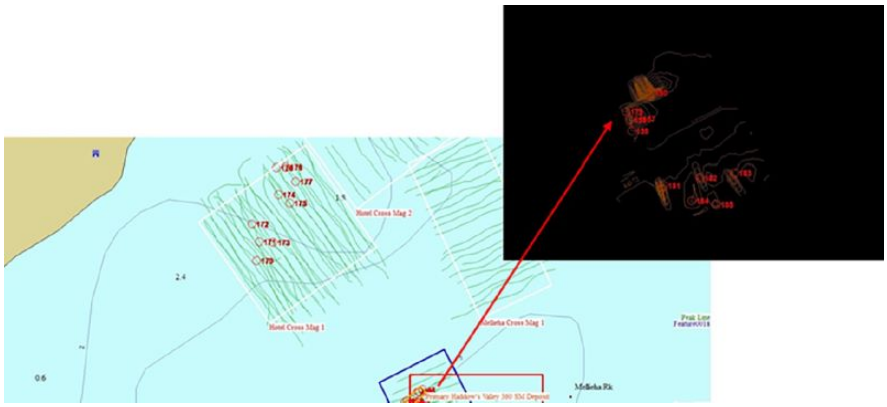


Figure 8: The Haddow's Valley target area, highlighting the location of a dive ground-truthing survey, conducted around anomaly 179 (Gossage 2014,14).

Haddow's Valley measures approximately 50 m in length along a north-south orientation. The limits of the Valley are defined by a 4 m Poseidonia matte to the west and a Poseidonia sea grass meadow to the east (Gambin et al 2021, 12).
The archaeological potential of Haddow's Valley was first realised in Frosts' 1967 investigation, where excavation in the northern section of the Valley revealed mortaria and amphorae remains, with glass, metal, rosin, and frit uncovered in the southern section (Gambin et al 2021, 4). The mortaria formed the bulk of discovered material, with the site today aptly known as the 'Mortar Wreck' and dated to between the first and third centuries AD. The amphorae are dated to the third century AD, providing a consistent date for the wreck site (Gambin et al 2021, 6). The magnetic anomalies detected during the 2010 survey are located within the area investigated by Frost in 1967, forming approximately 2% of the 1967 excavation area. The 2011, a ground-truthing survey was carried out in this area, revealing the presence of scattered ceramic remains. The site was revisited in 2012 and was the focus of the 2013 field school organised by the University of Malta and the Honor Frost Foundation. During the field school Haddow's Valley formed the centre of investigations and was mapped and subsequently divided into different areas. Following the

documentation of the Valley, surface finds were identified, labelled and recovered. Excavation was concentrated in the northern section, owing to the shallow depth of bedrock towards the south of the Valley (Gambin et al 2021, 9). The 2014 field school season concentrated on the exploration and documentation of the areas surrounding Haddow's Valley. An inspection of the main Valley area revealed the presence of new surface finds, confirming the high-energy nature of the site (Gambin et al 2021, 10). The 2014 magnetometer survey was conducted within the context of this surrounding exploration, and when combined with the data gathered in 2010, two deposits can be identified, possibly related to each other. The anomalies were further divided in order to isolate and individualise each potential target. The 2014 data revealed a second area of isolated anomalies, potentially related to those documented in 2010. A possible interpretation of the data could be that of a shipwreck, or partial wreck and cargo, lying approximately 60 metres apart. A ground-truthing survey was conducted by divers in one of these areas, around anomaly 179 (Fig. 8). Several fist-sized non-indigenous rocks were noted along with what appeared to be a conglomerate of metal and rock. Substantiation of such interpretations can, however, only be confirmed or discarded through further investigation, or excavation.

Mellieħa-St Paul's Island survey

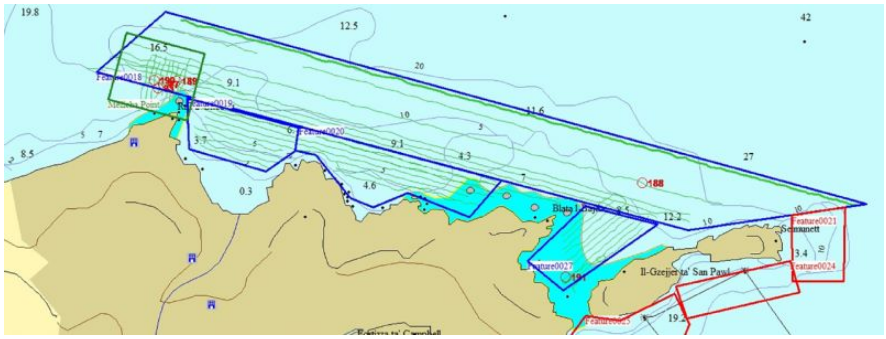


Figure 9: Mellieħa-St Paul's bay survey area (Gossage 2014, 16).

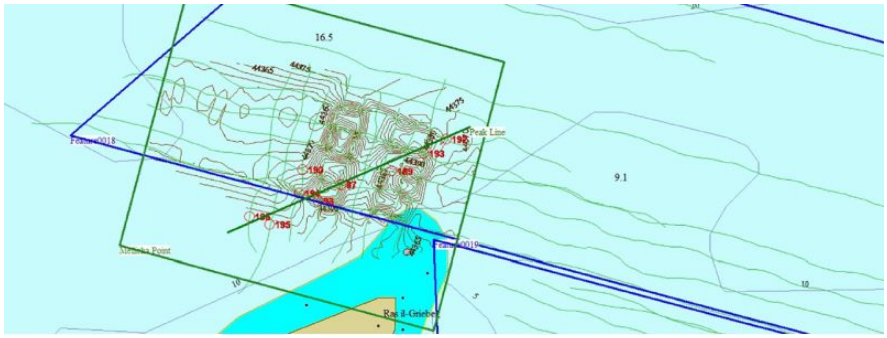


Figure 10: Potential feature area in small bay west of St Paul's (Drawn by S. Said 2013).

The 2014 survey represented the first exploratory survey of this area. Navigational charts of the area did not highlight any modern magnetic variances, and Professor Timmy Gambin, a maritime archaeologist, also expressed a lack of knowledge on known areas of interest in the small bay west of St Paul's Island (Fig. 9). The weather and heavy sea traffic in this area hindered the survey, and may have also impacted the quality of the data gathered. Nevertheless, a more complete magnetometer survey is warranted, if only to determine whether this is a true area of interest or not. Additionally, the data gathered over a large area located on the western end of the survey area, has revealed the presence of a magnetic ridge, 240 m in length (Fig. 10). Whilst this feature may be geological in nature, it is nevertheless a unique feature area when compared to other near shore areas that have been surveyed.

Conclusion

Magnetometers have been an essential tool in marine remote sensing over the course of the last half century. Whilst the use of magnetometers is usually reserved for the prospection of iron and steel remains, it can nonetheless be utilised to discover any other types of ferrous material, such as ceramics. The magnetometer surveys initiated in 2010 off the north-eastern coast of Malta identified a number of target anomalies or areas of interest in Mellieħa and Salina bays. The aim of the 2014 survey was to further define these areas, with the exclusion of Salina and St Paul's bay.

The 2014 magnetometer survey formed part of the University of Malta underwater field school. The results from this survey revealed the strong possibility of a substantial target in the 'Hotel Cross Mag 2' area, as well as a distinctly separate area of interest at the Haddow's Valley site, approximately 60 metres from the anomalies discovered in 2010. The ground-truthing survey conducted around one of the newly discovered anomalies (number 179) at Haddow's Valley exposed the presence of non-indigenous rocks and possible metal conglomerate. However, the positive identification of cultural remains would necessitate further excavation. According to the UNESCO Convention on the Protection of the Underwater Cultural Heritage, in situ preservation is the preferred option when it comes to activities directed at underwater cultural heritage. It is only in rare and unique instances that excavation underwater should be conducted. Moreover, access is hindered by the presence of Poseidonia mattes, protected under national (Legal Notice 311, 2006) and European legislation (Evans 2006). The destruction of Poseidonia mattes for

archaeological purposes would also require extraordinary circumstances to justify excavation through such an important natural resource. Moreover, the mattes protect any potential archaeology from natural and human-made destruction.
The regular inspection of the surveyed areas is seen as the preferred method of operation, ensuring that the Poseidonia matte, and therefore the potential archaeological deposits, remain intact.

Acknowledgements

The authors would like to thank the Honor Frost Foundation for the support provided throughout the consecutive field schools in 2013 and 2014, along with the Department of Classics and Archaeology at the University of Malta. Further thanks go to AquaVenture Dive School in Mellieħa for providing the diving equipment and storage facilities, as well as to all field school participants and visitors. Without their hard work the fieldwork and compilation of this report would not have been possible.

References

EVANS, D. 2006. The habitats of the European Union Habitats Directive. Biology and Environment: Proceedings of the Royal Irish Academy 106B (3): 167-73. DOI: 10.3318/BIOE.2006.106.3.167.

FROST, H. 1969. The Mortar Wreck in Mellieħa Bay. London: Apperton Press.

GAMBIN, T., SAID, S., SAUSMEKAT, M., YATES, P. 2021. Revisiting the Mellieħa Bay Wreck: A report on two seasons of survey and excavation (2013-2014). Malta Archaeological Review 12: 1-18. https://doi.org/10.46651/mar.2021.3.

GOSSAGE, D. 2014. Malta Marine Magnetometer Survey: Expanding the 2010 Mag Survey. Unpublished report.

GREEN, J. 2004. Maritime Archaeology: A technical Handbook. 2nd ed. Elsevier Academic Press: London.

GREEN, J. 2014. The Application of Aerial Magnetometers in Maritime Archaeology. International Journal of Nautical Archaeology. 43: 436-452.

Legal Notice 311 of 2006 ENVIRONMENT PROTECTION ACT (CAP. 435) DEVELOPMENT PLANNING ACT (CAP. 356). Flora, Fauna and

Natural Habitats Protection Regulations, 2006.

MARRINER, N., GAMBIN, T., DJAMALI, M., MORHANGE, C., SPITERI, M. 2012. Geoarchaeology of the Burmarrad ria and early Holocene human impacts in western Malta. Palaeogeography, Palaeoclimatology, Palaeoecology 339-341: 52-65.

PAPATHEDODOROU, G., GERAGA, M., CHALARI, A., CHRISTODOULOU, D., IATROU, M., FAKARIS, E., KORDELLA, S., PREVENIOS, M., & FERENTINOS, G. 2011. Remote sensing for underwater archaeology: case studies from Greece and Eastern Mediterranean. Bulletin of the Geological Society of Greece 44: 100-115.

PLETS, R., DIX, J., BATES, R. 2013. Marine Geophysics Data Acquisition, Processing and Interpretation: Guidance Notes. English Heritage. Available at: https://historicengland.org.uk/imagesbooks/publications/marine-geophysics-dataacquisition-processing-interpretation/ (As seen on 10 May 2021).

SØREIDE, F. 2011. Ships from the Depths: Deepwater Archaeology. Texas A&M University Press: College Station.

ŻAMMIT, C. G. 1960. Museum Annual Report 1959-1960. Malta: Government Printing Office.

ŻAMMIT, C. G. 1960. Museum Annual Report 1960. Malta: Government Printing Office.

ŻAMMIT, C. G. 1961. Museum Annual Report 1961. Malta: Government Printing Office.

ŻAMMIT, C. G. 1964. Museum Annual Report 1964. Malta: Government Printing Office.

ŻAMMIT, C. G. 1965. Museum Annual Report 1965. Malta: Government Printing Office.

Timmy GAMBIN is Associate Professor in Maritime Archaeology at the Department of Classics and Archaeology, University of Malta. He graduated in History from this University and went on to attain his Masters in Maritime Archaeology and History from the University of Bristol where he also got his doctorate in MaritimeArchaeology. Prof. Gambin has been involved in numerous collaborative research projects, and has also codirected

numerous offshore underwater surveys in various parts of the Mediterranean.

Douglas GOSSAGE has over 28 years of professional involvement in the underwater industries and environment. His career includes over 15 years of marine search and survey operations. He is an experienced dive instructor, underwater still photographer and videographer as well as an expert in sonar and magnetometer search techniques. In the more recent decade, Mr Gossage's career has included locating numerous shipwrecks, aircraft and other high value targets using all types of sonar equipment. In addition to his expertise with sonar systems, Mr Gossage is also an experienced magnetometer operator. As a survey technician, he has conducted thousands of kilometres of surveys under all types of environmental and seabed characteristics and conditions.

Maja SAUSMEKAT is an archaeologist and a graduate from the University of Malta, having obtained her Bachelor of Arts in archaeology and a Masters in Archaeological Practice from the same university. Ms Sausmekat joined the Heritage Malta Underwater Cultural Heritage Unit as the Underwater Archaeology Coordinator, combining a passion for research with the underwater world.

Malta Archaeological Review 2021, issue 12,
https://doi.org/10.46651/mar.2021.7
Received: 16 February 2021 | Accepted: 9 June 2021 | Published online: 6 October 2021

PDF Cite

« PREVIOUS
A report on the magnetometer survey results off the north-eastern coast of Malta 2010-2014: Mellieħa Bay, Salina Bay, and St Paul's Bay

NEXT »
Marsascala residents, NGOs want EU support

The Society (VO/0195) was founded in 1993 and is concerned with all matters pertaining to archaeology. One of its principal objectives is to promote and enhance the study of archaeology at all levels.

Contact the President

Contact the Secretary

Home

The Society

The Committee

Malta Archaeological Review

Membership

Links

Contact Us

2023: 01 03 05
2022: 01 05 06 08 10 11 12
2021: 01 05 10
2020: 01 02 03 07 09 11
2019: 01 02 03 04 05 10 11 12
2018: 01 02 03 04 10 11 12
2017: 01 02 03 04 06 09 10 11
2016: 05 10 12

Copyright © 2023 The Archaeological Society Malta and others. Hosted and supported by A6iT.