An Archaeological Survey of

Mount's Bay

Conducted by

Cornwall and Isles of Scilly Maritime Archaeology Society

CISMAS

Project Report

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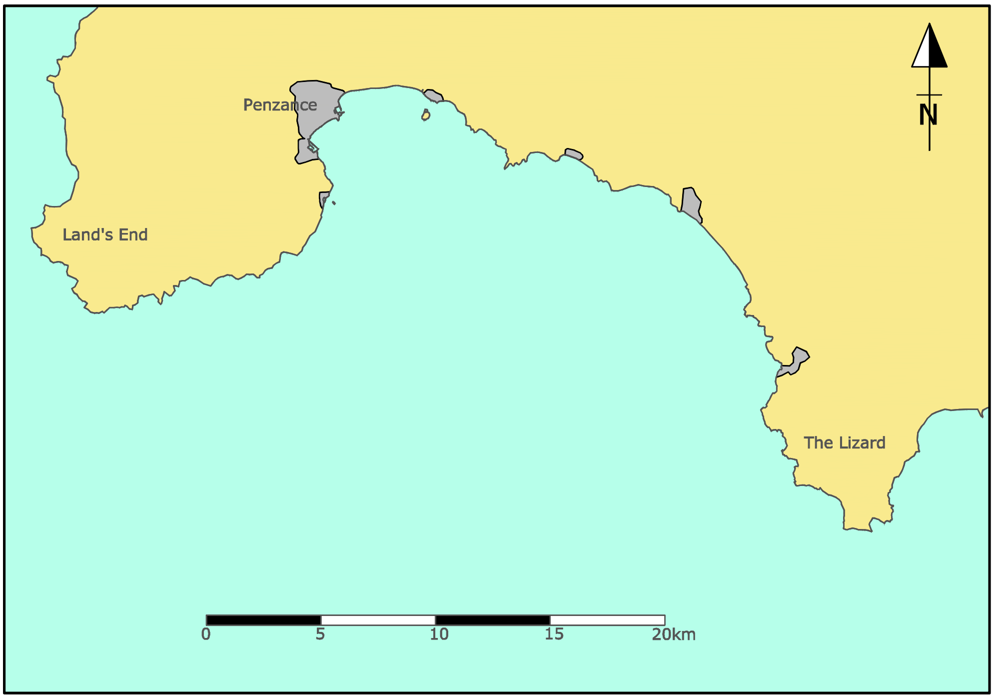
Introduction

This is the story of a search for historic shipwrecks in Mount's Bay. The term historic shipwrecks conjures up romantic images. However, as anyone who has ever looked for historic wrecks will tell you, the truth is much more mundane with many days of fruitless searching being more the norm. So why did we choose Mount's Bay for our search? Mount's Bay in the far south west of Cornwall takes its name from the Bay's most prominent feature, St Michael's Mount. The economy and transport links of the region have always been closely linked to the sea. Until the 19th century the sea was the only practical means of transporting goods to and from the region. Fishing has always been an important activity locally, and although the fishing industry is now in decline, Newlyn in Mount's Bay is home to the largest fishing fleet in the UK.

Fig 1

Mount's Bay



According to classical sources (Pytheas writing in 325BCE), tin mined in *Belerion* (Land's End) was transported by cart to the island of *Ictis* which was connected by a causeway to the mainland at low tide. From here it was traded with foreign merchants and taken away in ships. Many modern scholars believe that St Michael's Mount is the site of ancient *Ictis*. The tidal causeway to the Mount and its proximity to *Belerion* certainly lend weight to this identification. There has probably been a harbour on the Mount since the fourth century BCE. We also know that the Mount was an important harbour in medieval times, with evidence of tin trading and a fifteenth century light marking the harbour entrance at night. All this demonstrates that international trade by sea was taking place in Mount's

Bay, starting before the Romans came to Britain and continuing throughout the medieval period. This shows the potential for very early wreck remains within the Mount's Bay survey area. Very few of these early ship types have been found in British waters.

Given the history of Mount's Bay, the Cornwall and Isles of Scilly Maritime Archaeology Society (CISMAS) decided to undertake a survey in the bay to determine whether any historic wrecks remained on the seabed. This survey was undertaken between August 2006 and August 2008. With such a large area to cover, it was clear that simply searching the bay using divers was impractical. Accordingly we decided to use remote sensing devices in the first instance, to enable a large area to be covered relatively quickly. This is perhaps familiar to readers as "geophys", often referred to in popular television archaeology programmes. The devices employed were high resolution sidescan sonar, which gives a picture of the surface of the seabed, and a marine magnetometer, which detects iron objects on or under the seabed. The project was made possible by a grant from the Heritage Lottery Fund.

Fig 2 The skipper Bill Bowen at the wheel

Fig 3 Collecting magnetic and bathymetric data

Fig 4 Collecting sidescan sonar data

Fig 5 The survey equipment

History

Mount's Bay is an area rich in maritime history. Archaeological findings and classical sources demonstrate the existence of seaborne trade from prehistoric times, possibly as early as the Neolithic period some five thousand years ago. This maritime importance continues to the present day, Mount's Bay being home to the largest fishing fleet in the UK. The Bay provides shelter for vessels from northerly and westerly winds and is close to both mainland Europe and Ireland. The north coast of Cornwall is short of safe anchorages and is susceptible to persistent Atlantic swell prevailing from the north.

However, Mount's Bay is liable to experience severe sea conditions in both southerly and easterly winds, leaving any shipping caught within the Bay in peril from the reefs which occupy its shallower waters (Larn & Carter 1969, 154-5; Noall & Farr 1965). Instances of shipwreck have been frequent and salvage has in the past been part of the local economy. Indeed, many local houses are said to have been constructed from timbers salvaged from vessels wrecked on the coast. An example of this was found during renovations of the Tyringham Arms Public House in Lelant Downs. Formerly Trevarrack County Primary School, and built in 1879, the Tyringham Arms was found to have several ship's frames and sections of planking used in its construction (Randall, 2005).

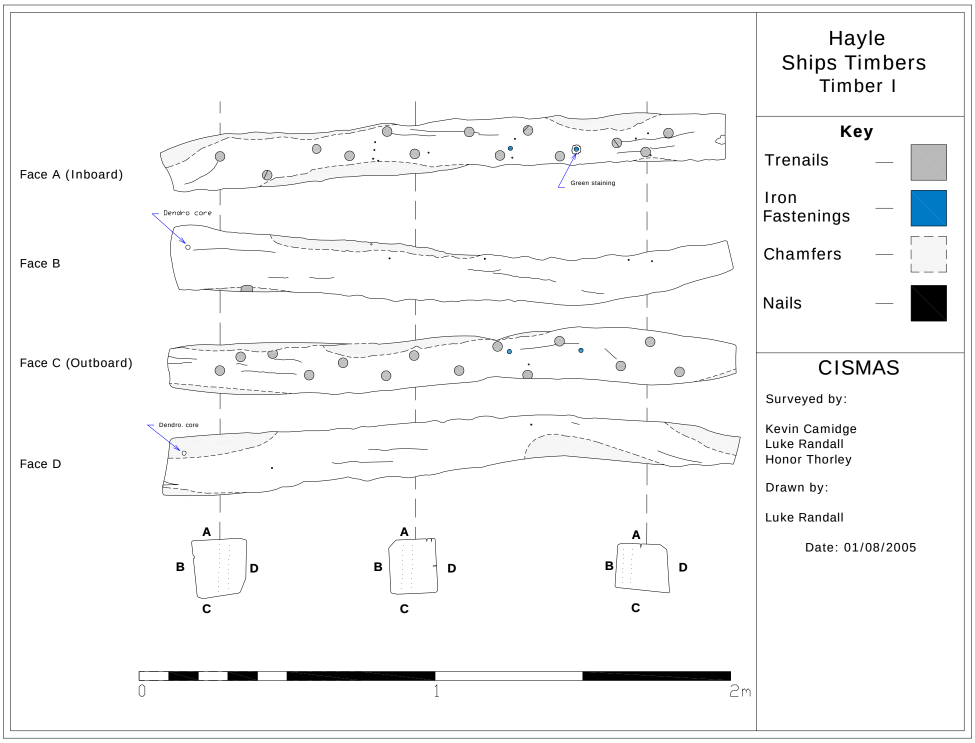


Fig 6

Scale drawing of ship timbers from the Tyringham Arms, Lelant Downs.

The archaeological potential of the Bay is significant, yet it remains a sadly neglected area. Little archaeological evidence of prehistoric, Roman or mediaeval shipwrecks has been identified in the bay. Only by focused underwater survey can we begin to connect the archaeological with the historical, and provide a clearer picture of the significance of Mounts Bay in the economic and social development of the south west of England.

A changing landscape

Over the past ten thousand years, increasing sea levels have significantly changed the shape of the European land mass and Britain (Johns *et al* 2004). The ready availability of drinking water, game and fertile land, as well as the warmer temperatures of coastal areas, render them ideal for settlement. Coastal settlement is obviously vulnerable to the impact of inundation.

The antiquarian William Borlase recounts the storm of 1758 when a large tract of tree stumps was revealed on the seabed at Long Rock by the receding waters, and there are numerous other examples of submerged landscapes around the Cornish coast. Since the end of the last ice age sea level has been continuously rising. Recent studies indicate that ten thousand years ago, sea level was approximately thirty five metres lower than at present, whereas by the Roman period, it was closer to three metres below present levels (Cullingford, 1998).

Submerged landscapes are of significant importance as they are able to provide information on the often poorly-quantified phenomenon of sea level rise. Furthermore, where contemporary archaeological remains are also identified, information can be gained which expands our understanding of the reaction of those communities affected by such a drastic change in their environment.

Early waterborne trade

The earliest evidence for waterborne trade in this area is the manufacture and distribution of ‘group one’ stone axes, which are made from stone peculiar to the Mount’s Bay area. These have been found as far away as Wessex & London, and analysis of their distribution suggests that they were transported by coast and then river (Chappell 1982, 200-3; Kain & Ravenhill 1999, 52; Griffith & Quinell 1999). Interestingly, archaeological finds from beneath the sands of Marazion include evidence of a Neolithic stone working industry (Sheppard 1980, 3-5).

An early Bronze Age (*circa*. 2000 BCE) gold lunula - a crescent shaped necklace - which originated from Ireland and was found in Cornwall - has been used to suggest that gold was traded for Cornish tin (Fox 1964, 23-5; Burl 2000). This would necessitate a substantial journey across open sea, including a small section of the Atlantic, and therefore would require a sea-worthy vessel or very benign weather. Evidence for the smelting of tin in prehistoric Cornwall was found at Chun Castle, near Land's End, during excavations in the early 20th Century (Leeds 1931).

Herodotus gives us the earliest historical reference to the tin trade between northern Europe and the Mediterranean, mentioning in approximately 440 BCE the supply of tin from the Cassiterides, or Tin Islands. Although the Cassiterides remain unidentified, there are three main candidates: north west Spain, Brittany and St. Michaels Mount (Muhly 1985, 287). In 325 BCE the Greek explorer Pytheas circumnavigated Britain (Ireland 1986, 13) and a recently-found Graeco-Roman anchor from North Wales attests to at least one such early voyage (Boon, 1975: 195-8). Diodorus Siculus writing in the late first century, recounts of Pytheas' journey:

"the inhabitants of Britain, who lie around the promontory of Belerium (Land's End) *are particularly hospitable and civilised in their way of life as a result of their dealings with foreign merchants. They it is who produce the tin, working the ground that bears it in an ingenious manner. This is stony and contains seams of earth in which they mine the ore and refine it by smelting. They hammer it into the shape of knucklebones and transport it to an island that lies off Britain called Ictis; for at low tide the space between is left high and dry and they transport the tin here in large quantities by means of wagons. A strange thing occurs around the nearby islands between Britain and Europe, for at high tide the causeways between them and the mainland are covered and they seem to be islands, but at low tide the sea recedes and leaves a large area high and dry so that they look like peninsulas. There (Ictis) merchants buy the tin from natives and transport it to Galatia ..."*

This description of a tidal causeway closely matches St. Michael's Mount.

Before the Roman invasion, the Veneti of north-eastern Gaul had extensive trading links with Britain and in particular the southwest (Mattingly & Jones 1990, 57-8). Julius Caesar – who was worried about the willingness of the Veneti to harbour malcontents - states that their sailing prowess afforded them a monopoly of the trade routes and that they managed a fleet of two hundred ships or more (Weatherhill 1985, 163). Diodorus also mentions Julius Caesar's report on tin ore which ensured that the economic exploitation of tin would begin in earnest as soon as the invasion of Britain was accomplished.

Fig 7

St Michael's Mount

Evolution of harbours

With the steady expansion of international shipping throughout the first millennium AD, several coastal settlements and harbours developed accordingly. With its origins as a harbour perhaps already some 3,000 years past, St. Michael's Mount was in 1206 awarded a royal grant to facilitate the construction of a breakwater. In 1306 the priors of the Mount supported the small settlement of Marazion and by the fifteenth century St Michael's Mount and Penzance were licensed for the transportation of pilgrims (Page, 1906:482). The Mount had become a place of religious interest and pilgrimage, being the focus of the cult of St. Michael the Archangel (Snell 1957, xx-xxii) and would, by the fifteenth century, be a departure point for pilgrims intending to visit the shrine of Saint James of Compestella in northern Spain.

The construction of a stone pier at Mousehole in 1392 (Page 1906, 482), one at St. Michael's Mount in 1427 and another pier at Newlyn in 1435 (Pearse 1963), all indicate an increase in seaborne traffic (Elliott-Binns 1955, 271). As commercial shipping increased so too did the need for safe navigation. In 1433 Sir John Arundel bequeathed money for the maintenance of a light on St. Michael's Mount, which was succeeded by a similar bequest in 1515 by Peter Bevill (Hague 1968-69, 64).

In 1284 the settlement of Penzance was merely a small rocky headland jutting into the Bay. Yet by 1498 the port-books and custom accounts of Penzance show increasing maritime trade with Brittany. In particular the ports of Ushant, Lantrégan, and St. Brieuc brought mixed cargoes of salt, linen, cloth and canvas, returning with Cornish herring, woollens, pilchards and tin (Rowse 1941, 73). In

1512 the harbour of Penzance is mentioned in a royal grant by Henry VIII (Polsue 1867-73, 235; Sheppard 1980, 2).

Following the burning of Marazion in 1514 by a French fleet of thirty ships, these vessels were met and defeated in battle by an English fleet commanded Sir Anthony Ughtred. Although a major action, this was unrecorded in the State Papers, yet a near contemporary map of Mount's Bay depicts it (Page 1906, 484). The military importance of the Mount in 1525 was such that a captain of the Mount was stationed with one priest and five soldiers. Cannon were installed for the defence of the whole Mounts Bay area, specifically the great harbour used for the loading of ships which depended on a fortified stronghold (Rowse 1941, 257). In 1595 the settlements of Mousehole and Penzance were burnt by Spanish raiders landing from four galleys (Pool, 1974).

In 1625 Penzance petitioned for a fort to protect the town (Page 1906, 496). Throughout the late 1620s, however, Algerian and Salee pirates continued to raid the area. By 1636 these Mediterranean pirates could be seen daily from shore, with reports of many ships and people being taken as slaves.

Wreck

There are at least two hundred known instances of vessels foundering between the Lizard Point and Runnel Stone (Larn & Carter 1969). This, although almost certainly lower than the true number of shipwrecks, is a testament to the risks facing the crews of those ships operating in, or visiting, the Bay. Many of these may have been refloated if not severely damaged, or stripped down and salvaged completely leaving little or no evidence of the event.

Of the known wreck sites in Mount's Bay, five have been designated under the *Protection of Wrecks Act 1973,* which protects a total of sixty-one sites in UK waters. The earliest of these five shipwrecks is the Portuguese carrack St. Anthony which foundered near Gunwalloe Cove in 1527 whilst on route from Lisbon to Antwerp. The St. Anthony, flagship of King John III of Portugal's navy, was carrying a cargo of silver and copper ingots and bronze candle sticks, many of which have been found since her rediscovery in 1981. South of Gunwalloe Cove not far from the wreck of the St. Anthony, lies the remains of the Schiedam. Taken by Sir Cloudesley Shovell as a prize from the Corsairs, she served as a Sixth Rate ship of the line until she was driven ashore at Jangye Ryn in April of 1684. These two wrecks sites, along with the Loe Bar wreck, Rill Cove Wreck and Royal Anne Galley are part of the wealth of maritime archaeology already known to be present within the bay.

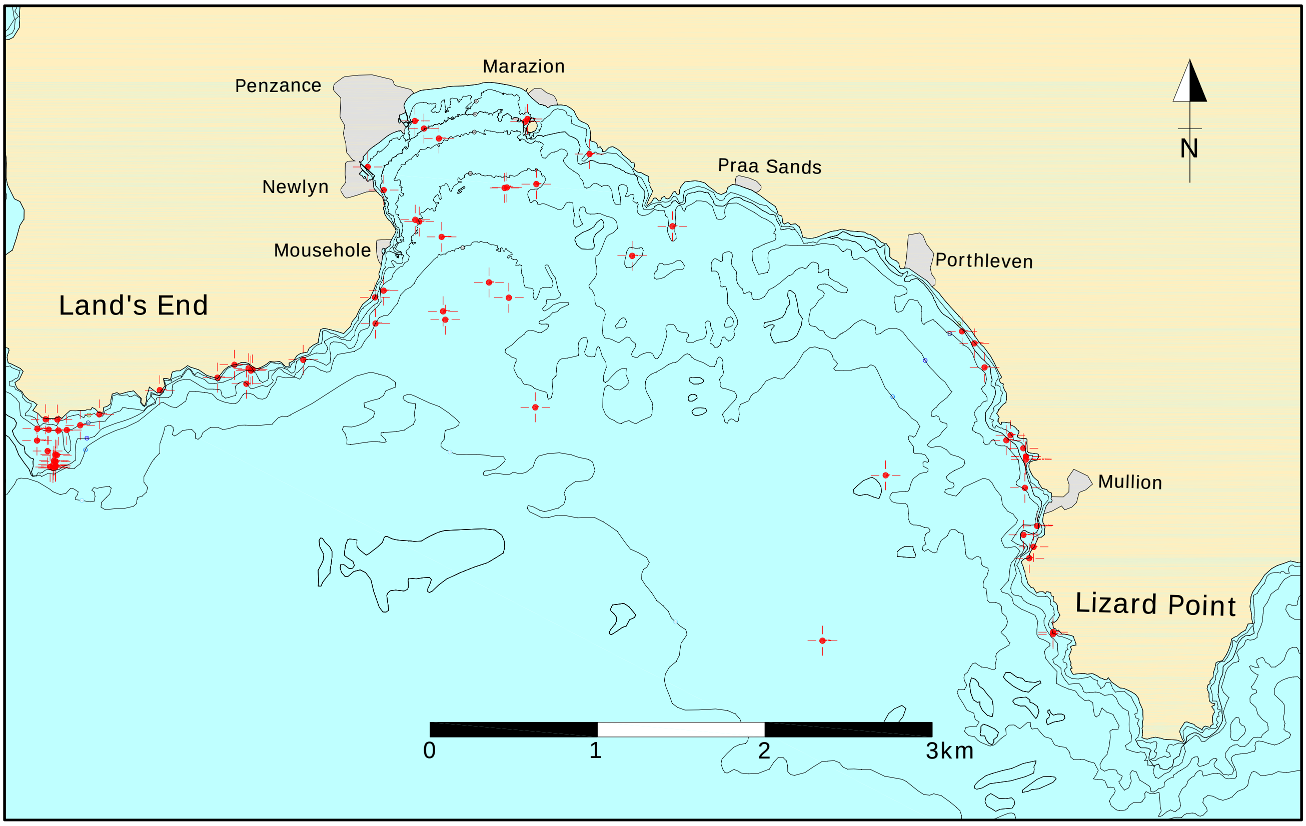


Fig 8

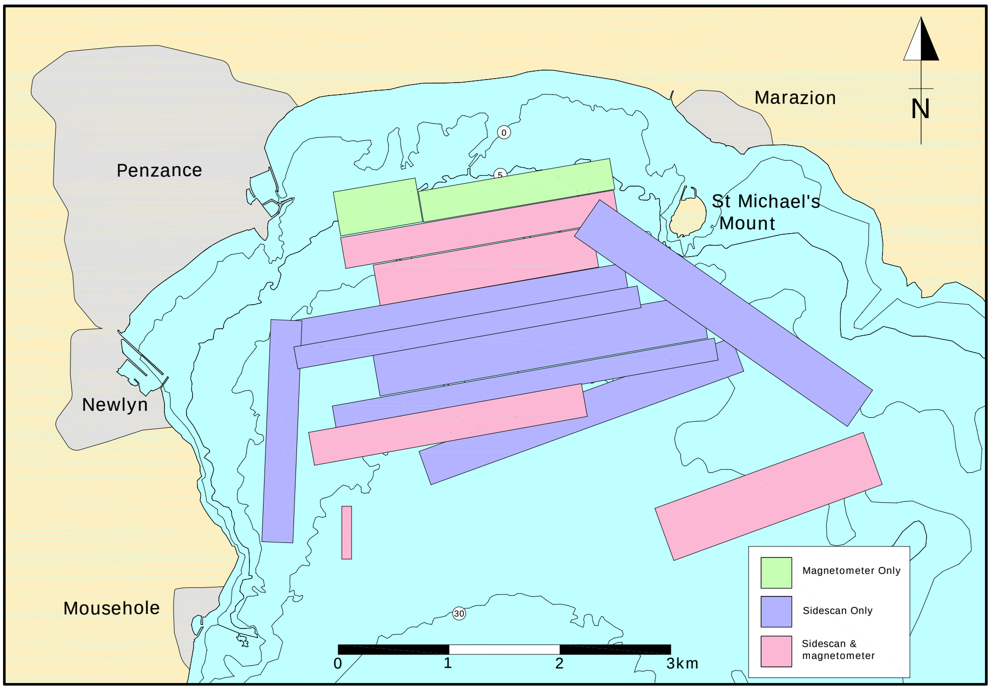
Distribution of shipwrecks within Mount’s Bay that are known to the UK Hydrographic Office

Survey methodology

Geophysical prospection was the key method of survey within the Mount's Bay project. Due to the large area of Mount's Bay (Fig 1) the principle geophysical survey was focused on the body of water between Penzance and St. Michael's Mount, extending south as far as the 20m depth contour. This area was selected due to the historical evidence for early and continuing seaborne trade operating here and the possibility of vessels being wrecked by strong southerly winds whilst on approach to one of the three harbours: St. Michael's Mount, Penzance and Newlyn. The geophysical survey, conducted over three seasons of field-work, covered a total area of approximately 10 km^2 (Fig 9).

Fig 9

Areas searched by geophysical survey



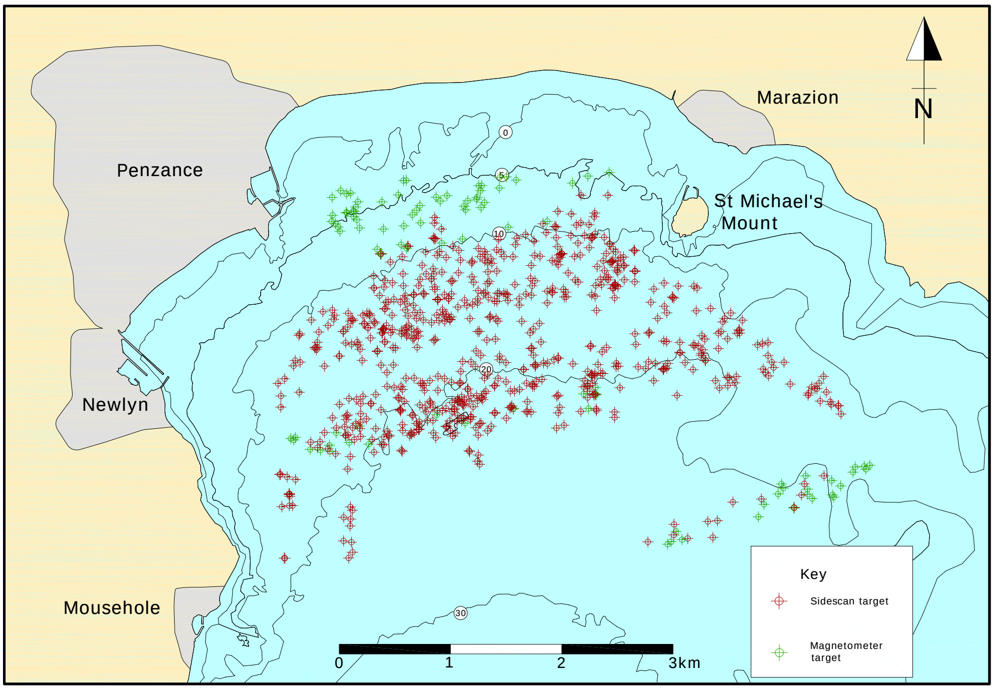
Three forms of geophysical prospection were used by CISMAS during the Mount's Bay survey; magnetometer, sidescan sonar and bathymetric data were collected. Magnetometry and sidescan sonar can each be considered independent forms of geophysical survey, whereas the bathymetric data was collected selectively to facilitate interpretation of the primary geophysical data. The geophysical survey was conducted over four dedicated weeks of field survey and supplemented, where opportunity allowed, by briefer spells at sea.

All geophysical instruments were operated via laptops to which they were connected aboard the survey vessel. All the equipment was powered by 12v lead acid batteries which were independent of the vessel's own power supply. Positional data was provided by a high quality, EGNOS-enabled Global Positioning System (GPS), with a dedicated spare always available should one fail to operate.

All magnetometer, bathymetric and related positional data were collected using Site Searcher Software, a dedicated marine geoprospection software package developed by Peter Holt of 3H Consulting. Site Searcher was also used as a navigational tool, allowing the helmsmen to keep track of his position and stay on the desired course whilst collecting geophysical data. During the first week of the geophysical survey CISMAS was assisted by Sarah Chaddock, a professional Hydrographic Surveyor who volunteered her time and expertise to aid the initial set-up of hardware and personnel training.

Fig 10

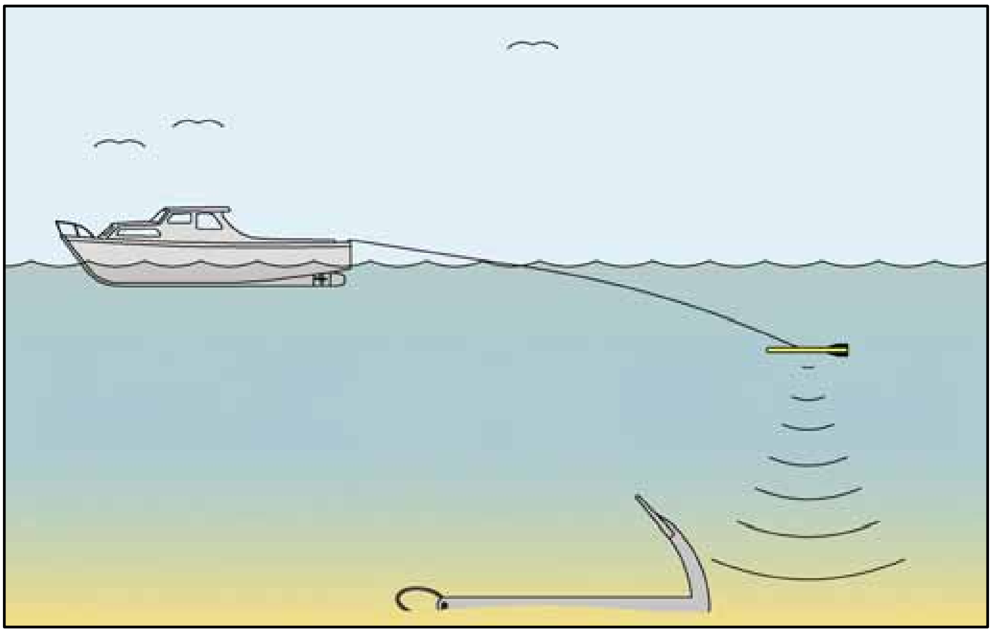
Distribution of sidescan sonar and magnetometer targets



During the first week of survey, CISMAS tested two different software packages designed for the collection and management of sidescan sonar records. The first of these, Hypack, is a well known commercial software package designed for use with many different models of sidescan sonar and which offers a range of post-processing functions such as the automated construction of mosaics. The second, MaxView, is produced by the manufacturers of the C-Max sidescan sonar owned by CISMAS and is designed for use with their own hardware. After this one week trial period, CISMAS opted to invest in C-Max's MaxView software as, although it does not offer supplementary functions such as image mosaicing, it proved to be more robust and simpler to use than the Hypak software.

Fig 11

Towfish deployed behind the survey vessel



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Both the magnetometer and side-scan sonar data were collected by deploying the towfish behind the survey vessel on a tow cable (Fig 12). Although magnetometer and side-scan sonar data were on occasion collected simultaneously, the task-loading involved rendered the process difficult. Therefore, where it was deemed desirable to collect both forms of data for the same search area, the area in question was surveyed separately.

Layback corrections need to be applied when conducting a towfish survey as the GPS unit which determines the position is mounted on the survey vessel, not the towfish. Although both Site Searcher & MaxView are designed to automatically apply layback corrections to the positional data, before either software package can do this it must be informed of the *layback distance* - the horizontal distance between the GPS antenna and towfish.

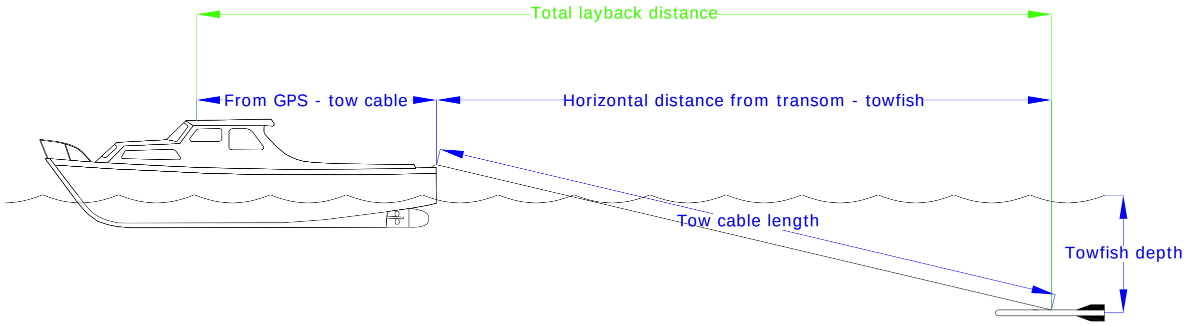


Fig 12 The key factors considered when calculating layback distance

Sidescan sonar survey

The sidescan sonar survey was undertaken using a C-Max CM2 sidescan sonar system (Fig 13) which was purchased by CISMAS for the purposes of conducting the Mount's Bay survey. Sidescan sonar data is represented by a digital image (Fig 14), which is in many ways similar to a photograph and which is thus intuitively interpreted. Unlike magnetometry, a sidescan sonar survey can be used to identify any object sitting above the seabed, from fishing nets to steel wreckage. This means it is well suited to the identification of older vessels of timber construction.

Fig 13

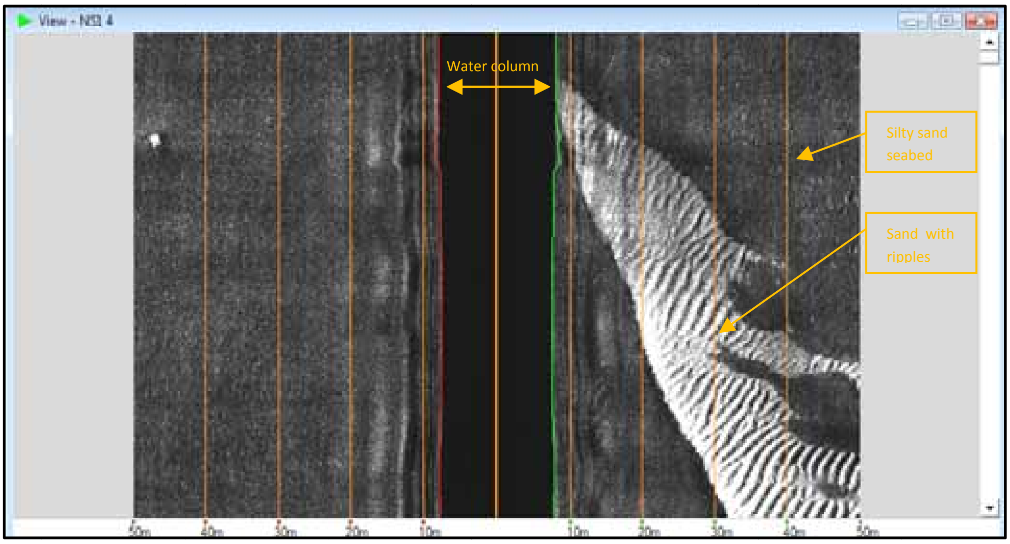
C-Max Sidescan sonar fish

The principal difference between a photograph and a sonar image is that the latter is a record of the reflection of sound rather than light. When in operation, the towfish emits pulses of sound or *pings* and then measures the reflected sound waves (fig 15). By measuring the strength of the reflection in relation to the strength of the original *ping*, the density of the reflective material is gauged. Similarly, measuring the time elapsed before a reflection is received allows the distance it has travelled to be calculated. Acoustic shadows are generated when an upstanding object interrupts the travel of the acoustic pulse preventing it from reaching the area beyond it, much as shadows are cast by light. These shadows can be used to calculate the height of an object on the seabed.

In total, an area of 9.2 km^2 (fig 17) was covered by the sidescan sonar survey and 733 individual targets identified. This ground was covered by surveying twelve separate search areas, each formed of individual search tracks. For the principal sidescan sonar survey, the CM2 system was operated at 325 kHz and a range of 50m. This means that an area 50m each side of the tow-fish was covered. This allowed for a rapidity of survey without compromising resolution. At a range setting of 50m, optimum search line spacing was set at 40m. At these settings, complete coverage of the search area was achieved. Thus the entire seabed within the search area was recorded at least once and approximately 60% was surveyed twice (fig 16).

Fig 14.

Example of a sidescan sonar trace



CMAX CM2 Sidescan Sonar System		
Frequency	325 kHz	780 kHz
Lateral resolution	78mm	39mm
Available ranges (port & starboard)	25m 50m 75m 150m	12.5m 25m

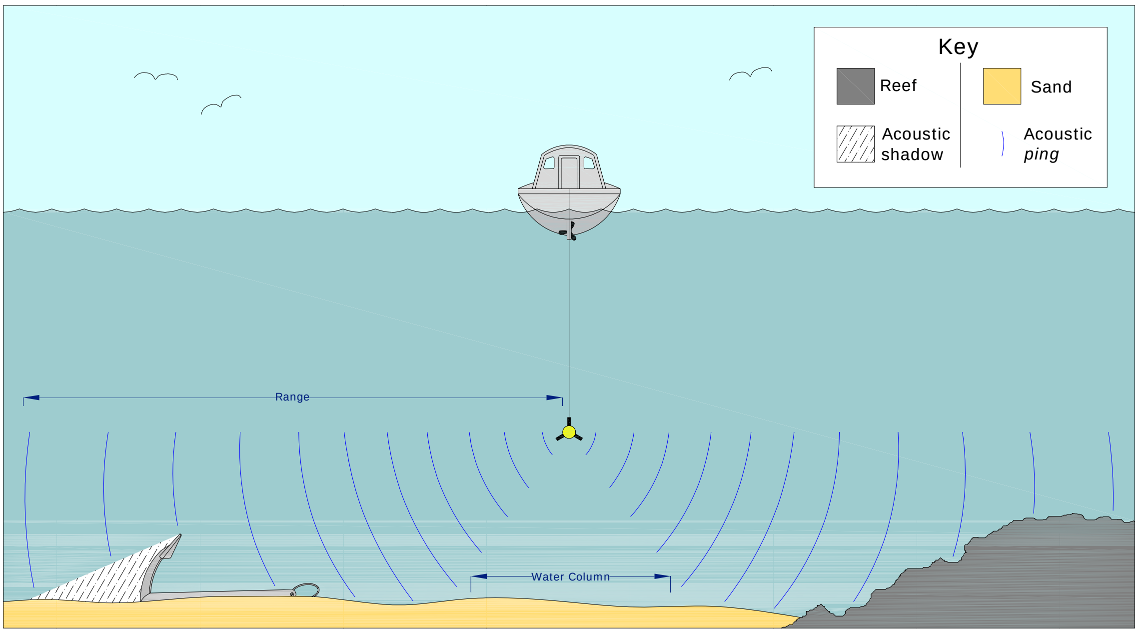
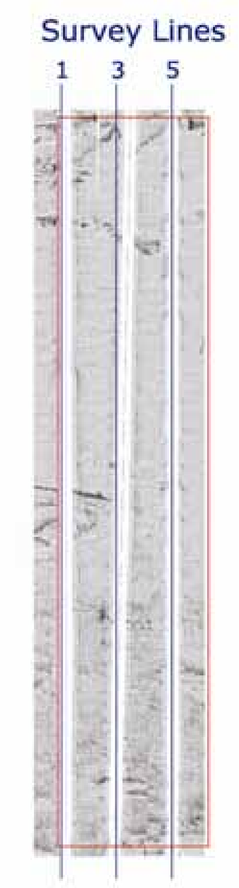


Fig 15 How the Sidescan sonar image is formed



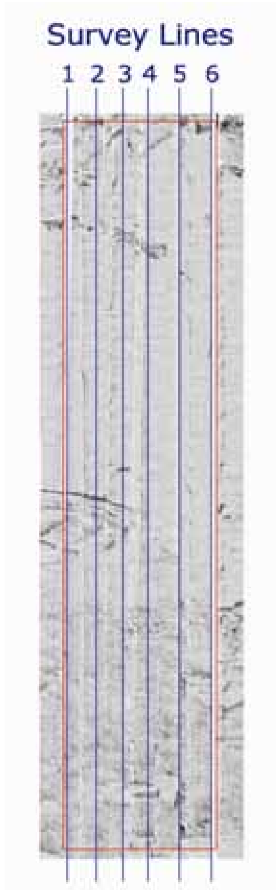


Fig 16

Sidescan sonar overlap

Left shows sidescan traces with 50m range and 80m line spacing, resulting in incomplete coverage

Right shows the same range with 40m line spacing – giving complete coverage

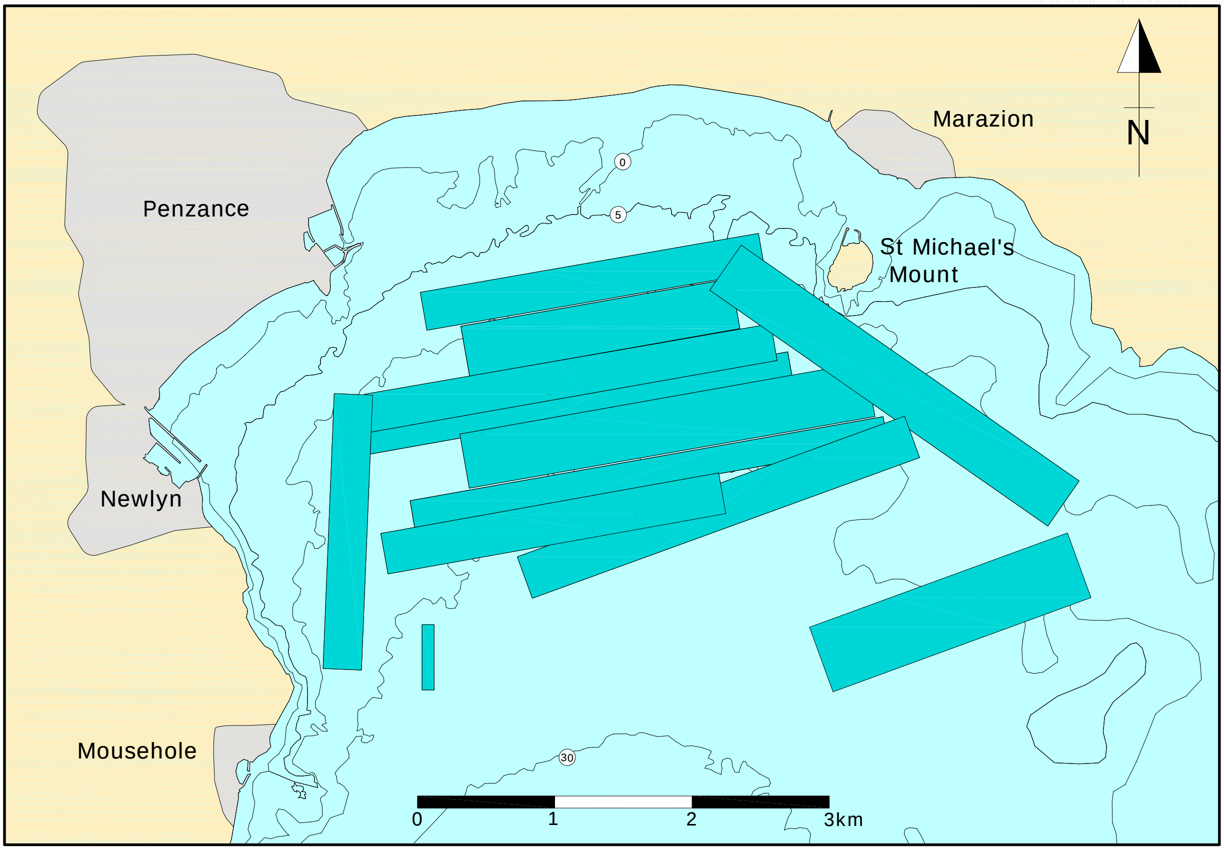


Fig 17 Base map showing the area covered by the sidescan sonar survey.

Targets were selected from the recorded sidescan sonar data at the conclusion of each day's survey. Although many forms of target, such as anchors or steel wreckage, are often easily recognised, target selection is to some extent a subjective process. An upstanding object seen on an otherwise flat seabed is often hard to categorise other than as simply being highly visible - and objects within a reef or area of rocks can be very difficult to distinguish.

In order to determine which targets should be investigated at a later stage in the project, it was agreed that a system of target prioritisation should be implemented. As the sidescan sonar records where individually scrutinised, any anomaly which was considered a target was both numbered in sequence and issued a letter from A to D in order to indicate priority, from high to low respectively. At early stages, any type of anomaly which had hitherto not been investigated would be prioritised, to aid future interpretations of similar examples. Representative high priority targets that were investigated in the course of the survey can be seen in Figs 18a-18d.

Figure 18a

Target A324
Iron wreckage on a silty seabed.

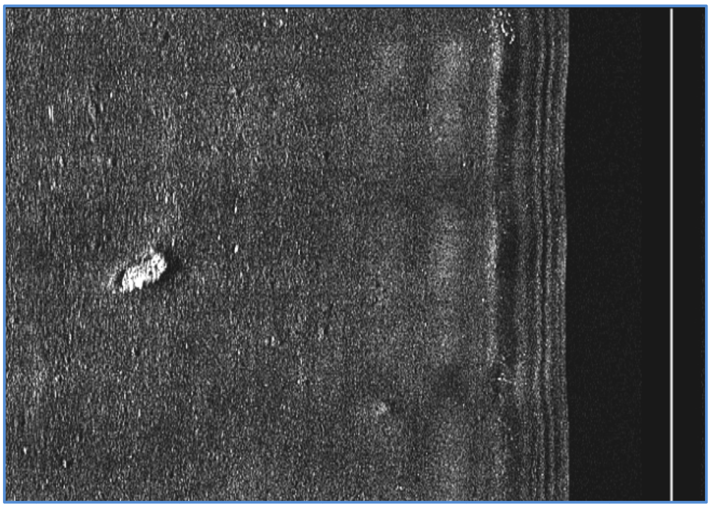


Figure 18b

Target B644
stockless anchor.

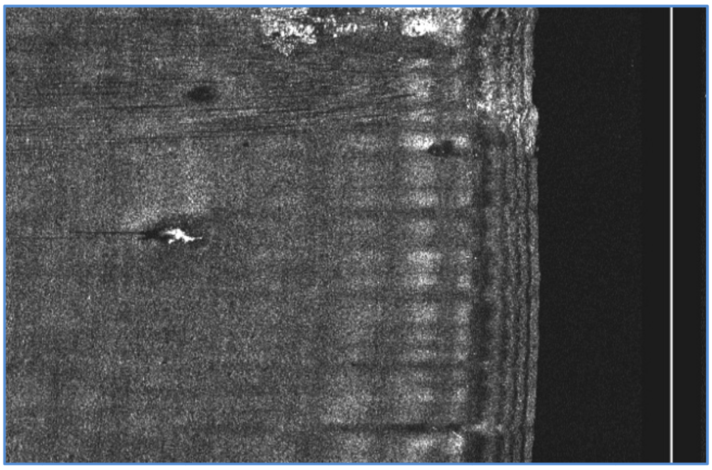


Figure 18c

Target B823, an outcrop of rock on a silty seabed.

Figure 18d

Target B570, abandoned fishing gear.

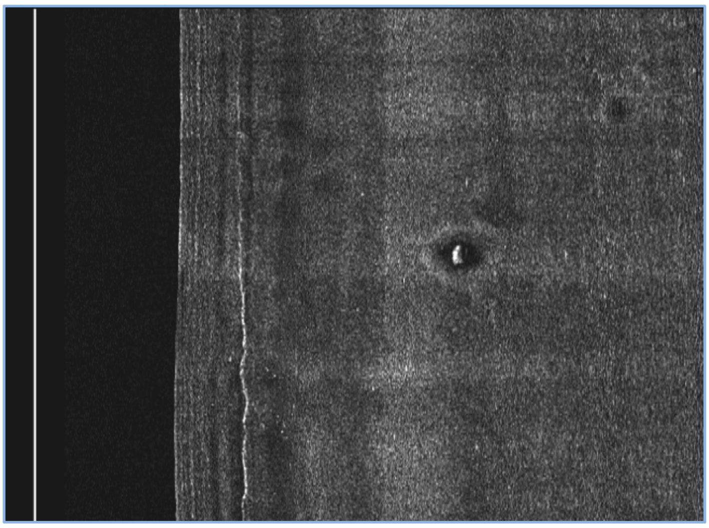
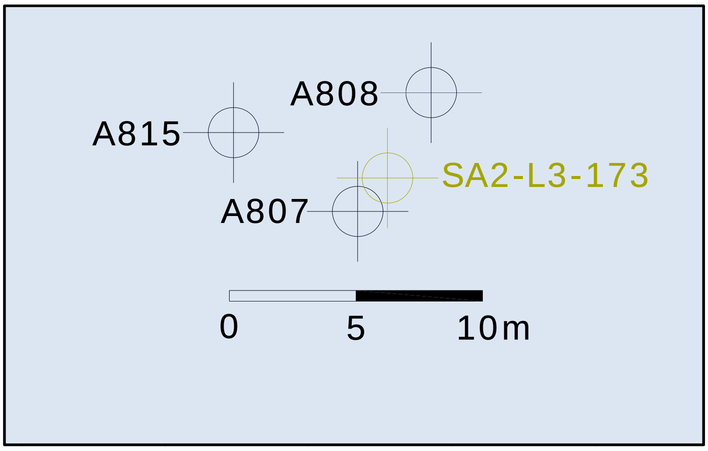


Fig 19

Three sidescan sonar targets (A807,A808 and A815) each representing the same seabed target recorded on three separate run lines - and corresponding magnetometer target SA2-L3-173



The positional accuracy of the CM2 sidescan sonar system, in conjunction with a Garmin 76 GPS unit, proved to be of good quality. Typically, the target material was observed by divers within six metres of the shot line deployed for their circular search, and was on occasion considerably closer. This accuracy is also demonstrated by the correlation of targets derived from different sidescan records which clearly represent the same material. Such is the case with targets A807, A808 and A815, all of which represent the same target material as viewed on three separate search lines and with no greater separation than 7.5m (fig 19).

This accuracy is in some part accounted for by the layback and offset calculations which are automatically applied within the C-Max software. These functions represent a significant improvement upon similar software packages used by CISMAS on previous projects (Camidge 2005:21).

At the end of geophysical survey work in 2008 all sidescan records where mosaiced to form a single, georeferenced image (fig 20). This mosaic was generated by combining individual records using Adobe Photoshop CS3, a photo-manipulation software package, creating single images for each search area. These individual mosaics where then georeferenced within AutoCAD, using targets and prominent geological features for which positional data was known.

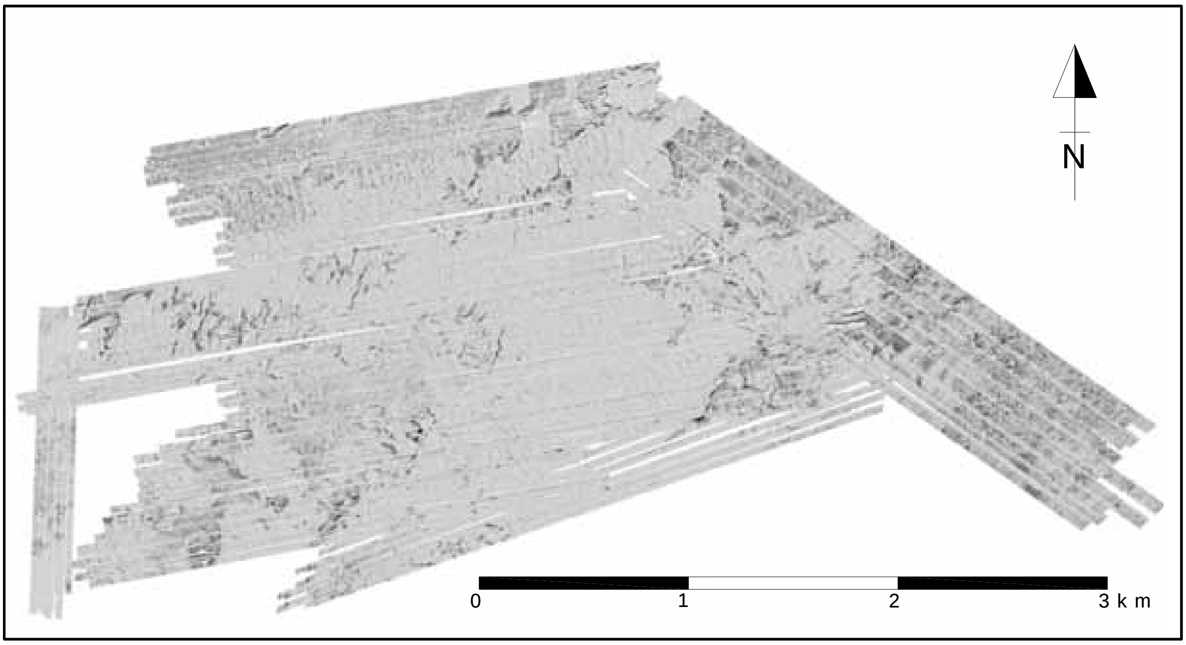


Fig 20 The georeferenced sidescan mosaic.

From this georeferenced mosaic, a thematic map was produced which depicts areas of varying seabed composition (fig 21). This image differentiates between three types of material: reef, consisting of boulderous areas or outcrops of granite; coarse sediment, predominately coarse sand; and fine sediment, predominantly fine silt. Although this information does not form part of the principal Mount's Bay dataset it will be expanded should new areas be surveyed. Furthermore, if CISMAS wish to return and resurvey some of the areas covered previously, information can be ascertained pertaining to the nature of sediment mobility within this section of the bay.

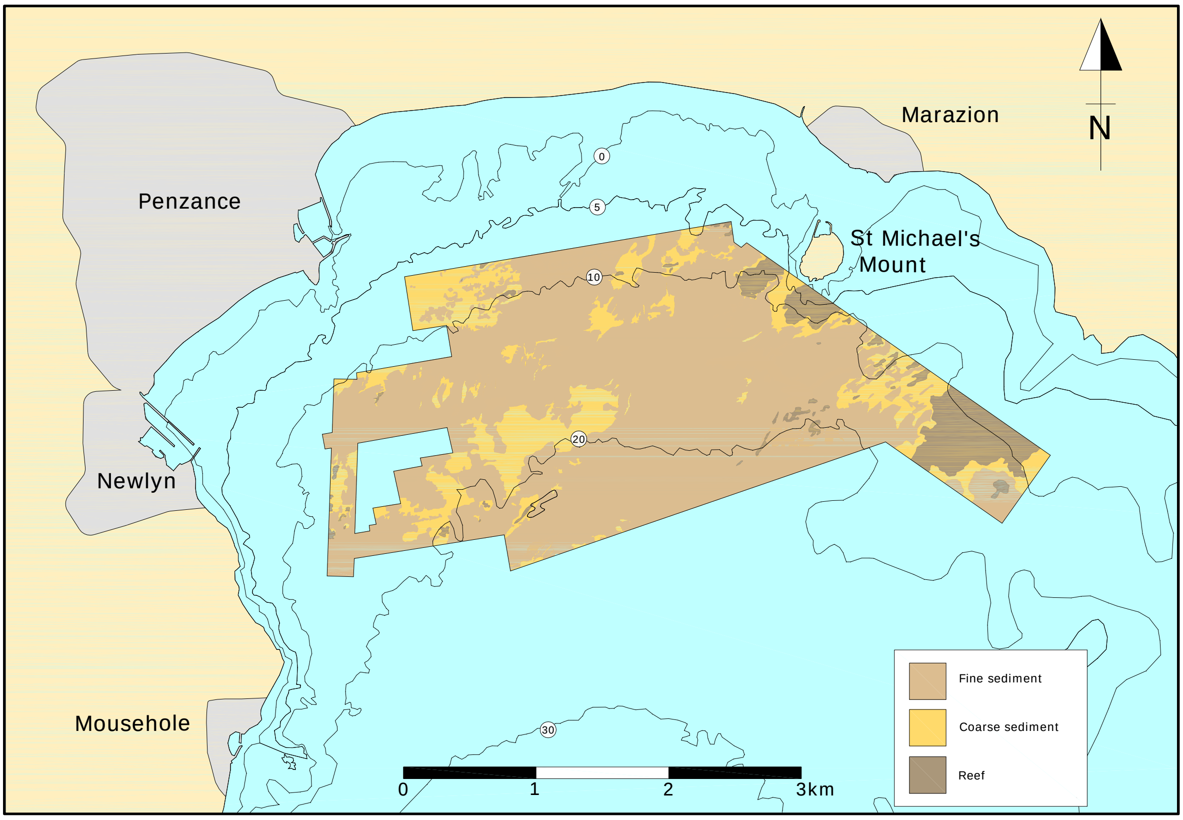


Fig 21 The thematic map of seabed composition derived from the sidescan record mosaic.

The sidescan sonar survey conducted by CISMAS was very successful. Target positions were consistently accurate and the investigation of targets was typically fruitful, with 66 out of 77 such investigations successfully locating objects which accounted for the anomaly seen on the sidescan image. The extent to which subjectivity in the interpretation of such anomalies affects the outcome of a survey of this kind is apparent. However, if interpretation is thorough, cultural material is unlikely to be missed, though geological material might be optimistically mistaken for cultural remains.

Sidescan sonar is not, however, a foolproof method of geophysical prospection. Artefactual material may accumulate within crevasses of a reef, where it might be hidden by acoustic shadows or disguised by the otherwise complex nature of the background. Similarly, areas of wreckage can easily be buried periodically by highly mobile sediments such as fine sands and silts. The periodic exposure of several known wrecks within the Bay is well documented and can render wreckage all but invisible to side scan sonar. It is for these reasons that a complementary form of geophysical prospection was implemented during the Mount's Bay project – the magnetometer survey.

Magnetometer survey

Fig 22

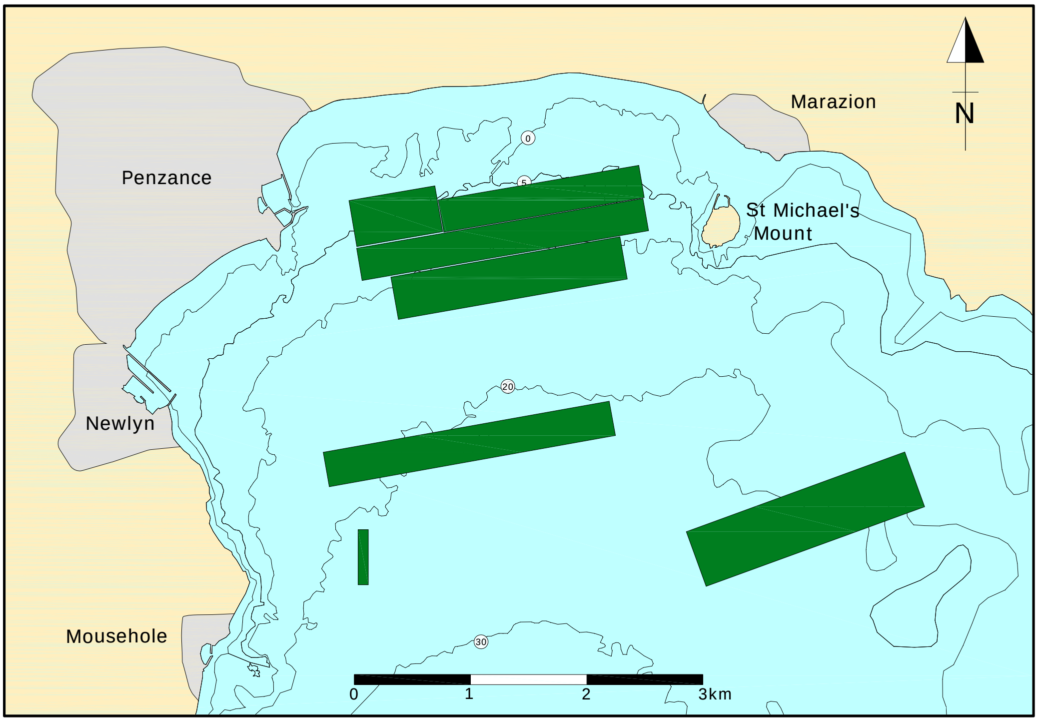
Geometrics G-881 marine magnetometer

The magnetometer survey was conducted using a Geometrics G-881 marine magnetometer (fig 22) loaned to CISMAS by St. Andrews University. Magnetometer data consists of a series of data points each representing a measure in nano-Tesla (nT) of the earth's magnetic field. Such measurements are taken by the towfish at timed intervals, recorded upon a laptop mounted aboard the survey vessel and georeferenced using data provided by the GPS unit. Throughout the Mount's Bay project an area of over 3 km^2 was surveyed by magnetometer (fig 23). This area was covered using six separate search areas, each consisting of search lines spaced 40m apart. The magnetometer was towed 30-40 metres behind the survey vessel to ensure that the data was not affected by the engine or electronic equipment.

Geometrics G-881 Caesium Vapour Marine Magnetometer	
Operating Range	20,000 nT to 100,000 nT
Sample Rate	1 to 10 Hz
Counter Sensitivity	Typically 0.005 nT @ 1Hz / 0.5 nT @ 10 Hz
Absolute Accuracy	< 3 nT throughout range
Operating Depth	Maximum of 200m

Fig 23

Search areas covered by the magnetometer survey

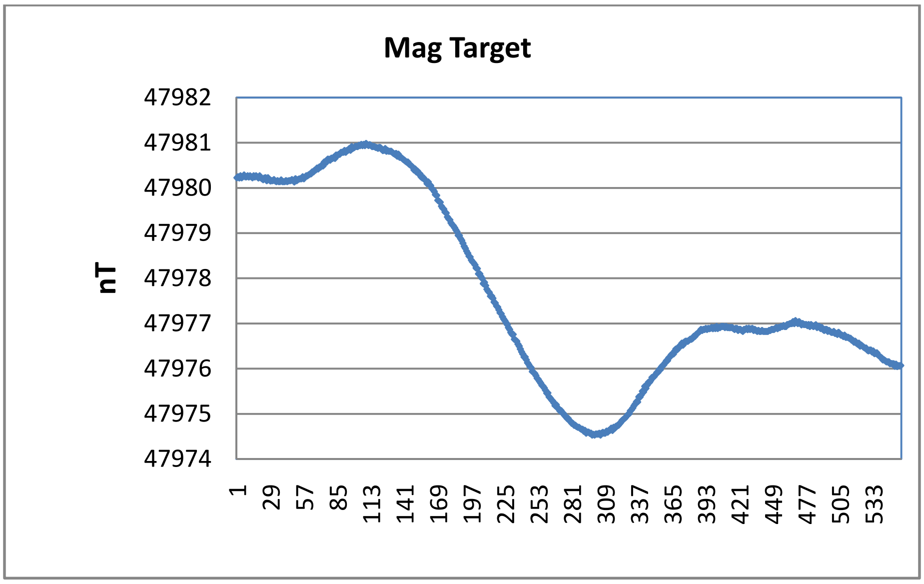


Unlike a sidescan sonar survey, which is capable of detecting objects on the seabed, a magnetometer will only detect ferrous material such as an iron gun or steel wreckage. When such items are present on the seabed, they create a deviation in the earth's magnetic field and it is these deviations – or *anomalies* – which are detected by the magnetometer and which can be identified as targets (fig 24). The magnetometer is capable of identifying material hidden from view among rocks or buried under sediment, whereas the sidescan sonar can only detect exposed material.

The magnitude of the magnetic anomaly produced by an iron object depends on its mass and distance from the magnetometer. Using this principal the *Hall Equation* can be used to estimate the mass of a particular anomaly (Hall, 1966). This estimate of mass is then used to aid interpretation of the target and to assign target priority.

Fig 24

Example series graph of a 6nT magnetic anomaly



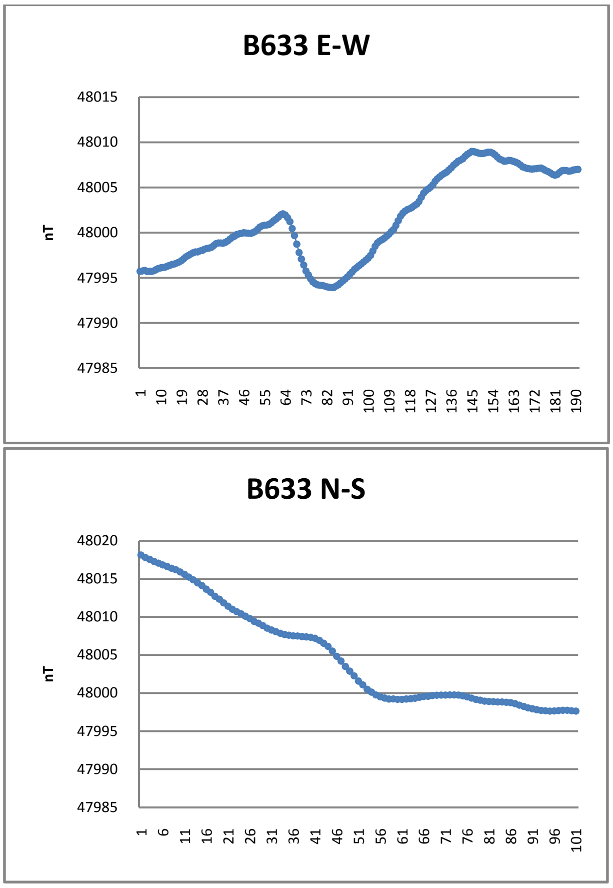
Deriving accurate positions for a target from observed magnetic anomalies is not possible. The position given for an anomaly is the position of the towfish at the peak of the relevant deviation. In effect we are recording the point of closest approach of the magnetometer to the target. The result is that, unlike sidescan sonar targets, magnetometer target positions are only approximations. If the same target is detected on adjacent run lines then a variation of the Hall equation can be used to iterate the most likely position of the target between the parallel search lines. Unfortunately in many instances the target is so small that it is only observable on the nearest survey track. However the method requires that the targets are indeed generated by the same object rather than two adjacent objects. In such instances this method of iteration cannot be used and the only position which is known for the target is the point when the magnetometer is at its closest to the target.

During the 2006 geophysical survey, a gradual undulating variation was detected in the magnetic field within Mount’s Bay. This variation, which covers too large an area to represent any archaeological material, is probably caused by magnetic properties of the seabed - possibly iron ore or magnetite present within veins of igneous rock which form part of the seabed of the bay.

Garmin 76C/CX	
Receiver	WAAS / EGNOS Enabled (DGPS)
Accuracy	GPS <10m / DGPS <5m
Update Rate	1 Hz
Interface	NMEA 0183 v2.3

Fig 25

Magnetometer series graphs showing the difference between E-W and N-S run lines over the same target



The impact of geological background variations such as this upon the magnetometer data is not fully understood. However, it has been observed whilst conducting a magnetometer survey of a known target that the bearing of the search tracks has a significant impact on the nature of the observed magnetic anomaly (fig 25). Further tests within the Bay are required if we are to fully understand the implications for magnetometry within Mount's Bay.

Further indications of strong geological influence upon the magnetometer dataset are evidenced by target SA2-L3-324 (fig 26a). This anomaly corresponded with two matching sidescan sonar targets B809 & B816 (fig 26b). When plotted, these two sidescan sonar targets, each from separate search lines, fell within 6m of each other and within 20m of the aforementioned magnetometer target. When investigated, no ferrous material was found but only a small elongated reef matching the sidescan sonar targets in both dimension and shape. Therefore it is probable that this magnetic target has a geological rather than an archaeological cause.

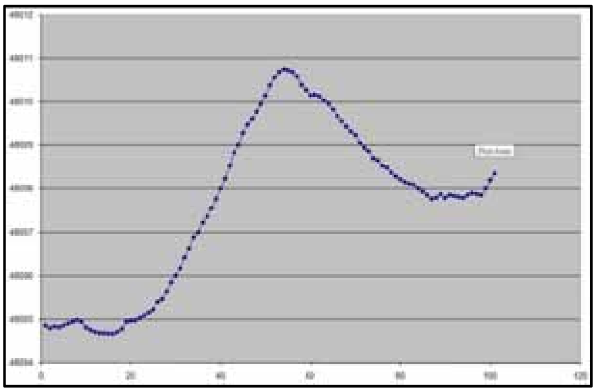


Fig 26a Magnetometer target SA2-L3-324

Fig 26b Corresponding sidescan target B816

In the course of the Mount's Bay survey nine magnetic anomalies were nvestigated by divers. Only one of these searches identified material which could have caused the anomaly being investigated. Aside from a poor understanding of the possible influences of magnetic rocks upon the magnetometer dataset, it is also apparent that much of the early magnetometer data collected in the course of the project was corrupted by an error in the positioning within the software being used (Site Searcher). Unfortunately, an incompatibility between an algorithm used in Site Searcher and the GPS unit resulted in unreliable positioning for magnetic targets. However this problem was identified, resolved and the new algorithm tested using targets of a known location prior to the onset of the 2008 geophysical survey.

The Hall equation allows an estimate of a target's weight to be made. Using the size of the recorded deflection and the distance between the magnetometer and the object, the mass of the target can be calculated. The size of the deflection is also influenced by the shape, or length: width ratio, of the object. A point target (1:1 ratio) will generate a smaller deflection than an elongated target (5:1 ratio) of the same mass (Green, 2004). The table below shows the size of deflection resulting from some typical targets.

Object		Deflection (nT) @		
Description	Mass (kg)	5 m	10 m	50 m
32 lb cannon ball (1:1)	14.6	1.2	0.2	0
Iron gun (5:1)	2000	800	100	0.8
Best bower anchor (1:1)	3000	240	30	0.2
Small iron wreck (5:1)	10,000	4000	500	4
Iron wreck (5:1)	100,000	40000	5000	40

Bathymetric survey

Bathymetric, or depth, data were collected to facilitate more accurate target mass prediction of magnetic anomalies. In order to use the Hall Equation, which relies principally upon input of target size and distance, we needed to know the water depth. This data was collected using a Garmin narrow-beam echo-sounder mounted on a steel pole which was secured to the side of the survey and tied off securely fore and aft to reduce vibrations induced by drag (fig 27).

Fig 27

Transducer suspended below water level.

Fig 28

Collecting bathymetric data.

Positional accuracy was maintained by taking offset measurements from the GPS antenna to the pole and of the transducer's depth below water level. These measurements were then fed into 3H Consulting's Site Searcher software prior to data collection to allow for real-time correction. Corrections for the state of tide where made in post-processing using similar functions within Site Searcher.

Accurate bathymetric data also increases understanding of the survey environment and can be applied to the thematic map of seabed composition (fig 29), thus allowing a continually developing dataset and the opportunity for comparative analysis should the same areas be revisited.

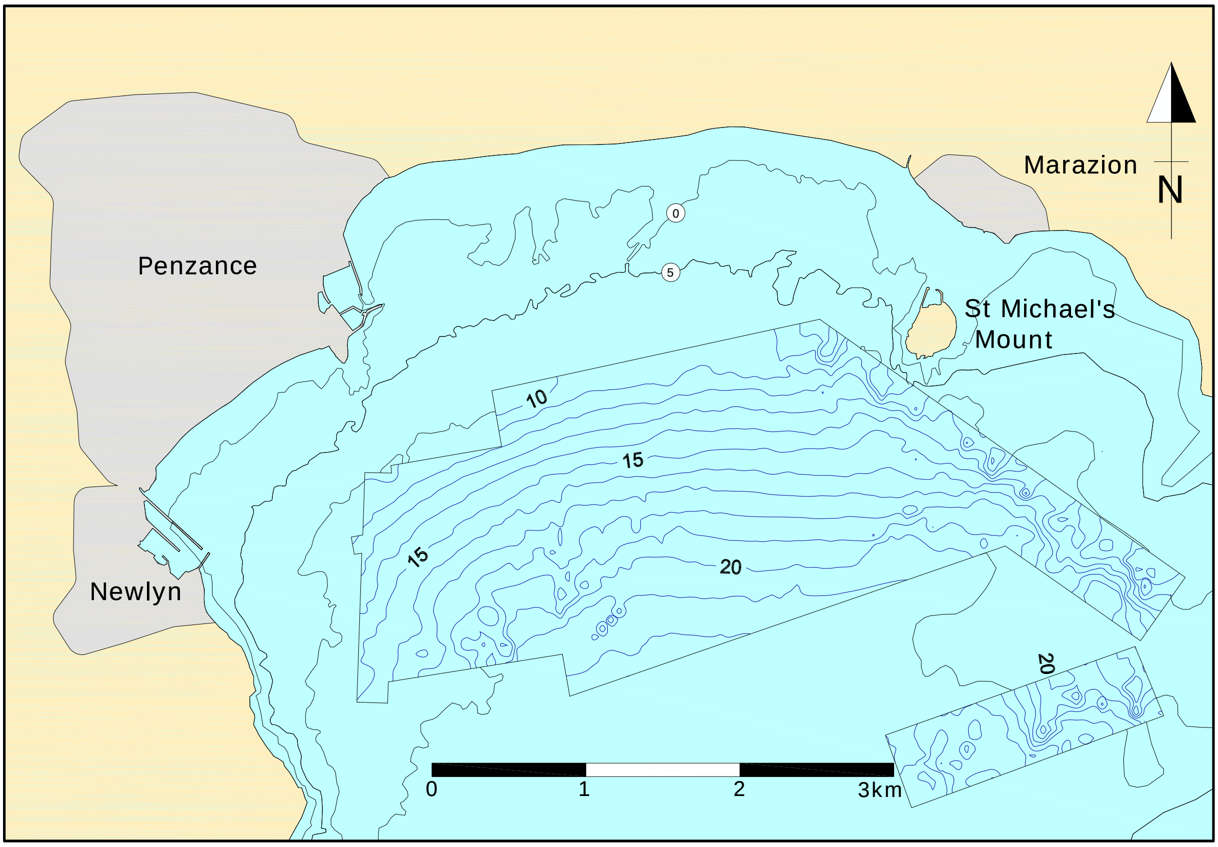


Fig 29 Basemap showing areas covered by bathymetric survey. Charted contours are at 5m intervals and shown in black; CISMAS bathymetry is at 1m contour intervals, shown in blue.

However, due to difficulties of rigging the bathymetric sensor, the use of this system proved very time consuming. As a result bathymetric data was only collected selectively to optimise available survey time.

Garmin Fishfinder 250	
Frequency	50 kHz or 200kHz
Sonar cone angle	40^{o} @ 50 kHz / 10^{o} @200 kHz
Interface	NMEA 0183 v2.3
Maximum range	< 500m

Searching

Over the course of the project two full weeks of field survey, one in 2007 and one in 2008, were dedicated to the investigation of targets selected from the geophysical dataset. This aspect of the survey allowed for the location, recording and interpretation of the sidescan sonar targets and magnetic anomalies. Such investigations were conducted by pairs of SCUBA divers performing circular searches of the seabed at the position of the recorded sonar or magnetic anomaly.

Fig 30

Diver enters the water from the survey vessel

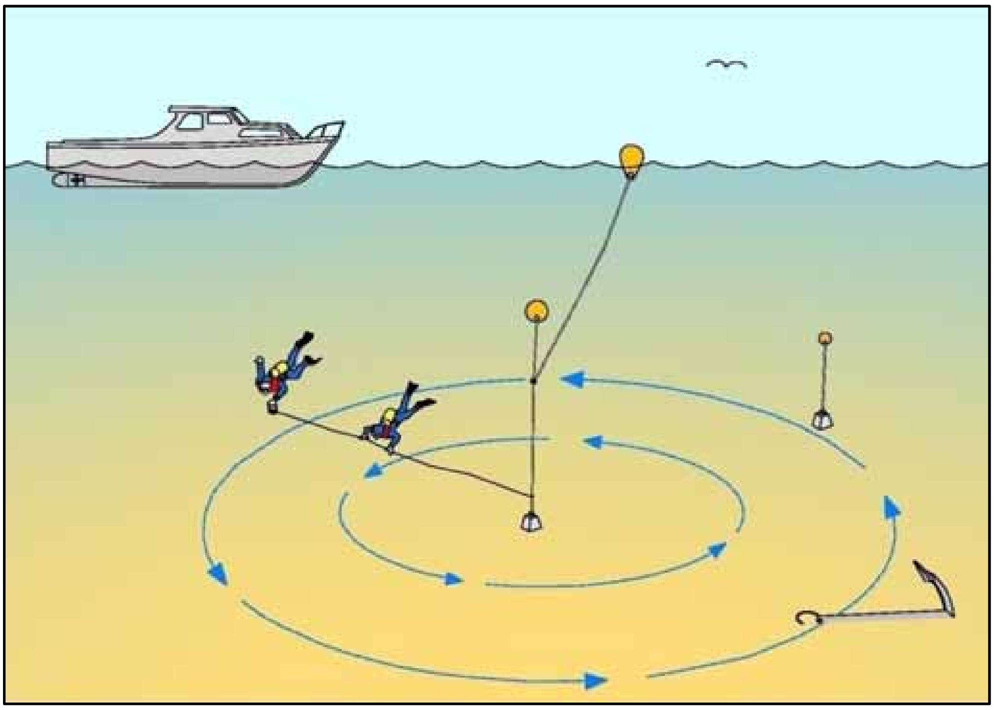
Prior to each field week, all target positions where uploaded into both of the CISMAS handheld GPS units, which avoided errors due to keying in positions to the GPS units. Bound target books were compiled containing descriptions and images of all sonar and magnetic targets. These books allowed targets to be chosen for investigation whilst at sea, so that weather conditions and water depth could be taken into account. Each target was given a priority letter (A to D) permitting divers to concentrate on the most likely targets. This also allowed for targets to be ticked off as a day progressed and for brief annotations to be made, thus ensuring that the same site would not be dived twice and providing an additional record of any material located.

Circular searches

Where a target was to be investigated, a 25kg shot weight and line would be dropped at the relevant position. This position was reached by giving both the helmsman and the individual deploying the shot line a GPS unit, both programmed to navigate to the desired target. When the GPS by the shot line indicated a distance to target of two metres or less, the shot was deployed. In addition to the main buoy, a smaller float was also secured to the line five metres from the weight. This intermediate buoy served to keep the lowermost section of the line vertical, thus ensuring that circular searches made from this line were as regular as possible (fig 31).

Fig 31

A pair of divers conducting a circular search.



Divers would descend the shot line and attach a distance line to its base and space themselves as far apart as visibility would allow, with the person closest to the shot ensuring that they could always see both it and their buddy (fig 32). Divers also carried a one metre length of rope, weighted at one end and buoyed at the other. This was deployed at the furthest extent of the distance line at the start of each search, so that they could identify when they had completed the circle. The distance line, marked every metre, was used to record the radius of the largest circle searched. This information was subsequently plotted on the base chart.

The size of the largest circle searched in each instance was dependent on a number of factors. In clear water and on a flat seabed with a minimum of weed, searches with a diameter of 50 metres could be completed. However, in poor visibility or amidst reef and heavy weed, careful searching could be a painstaking process. Yet a small area searched thoroughly provides a more useful record than a large area searched incompletely, and all divers were reminded of this.

Figure 32

Divers performing a circular search

In total, eighty-five targets were investigated in this manner, with the total area searched amounting to 82,900 m^2 (fig 33). In addition to recording equipment, an underwater metal detector was also carried on certain searches; predominately those investigating magnetometer targets. This equipment, which can detect both ferrous and non-ferrous metals, was used to search for items buried beneath sediment or concealed within reef or heavy kelp. Any objects or metal detector targets were recorded in situ by the divers.

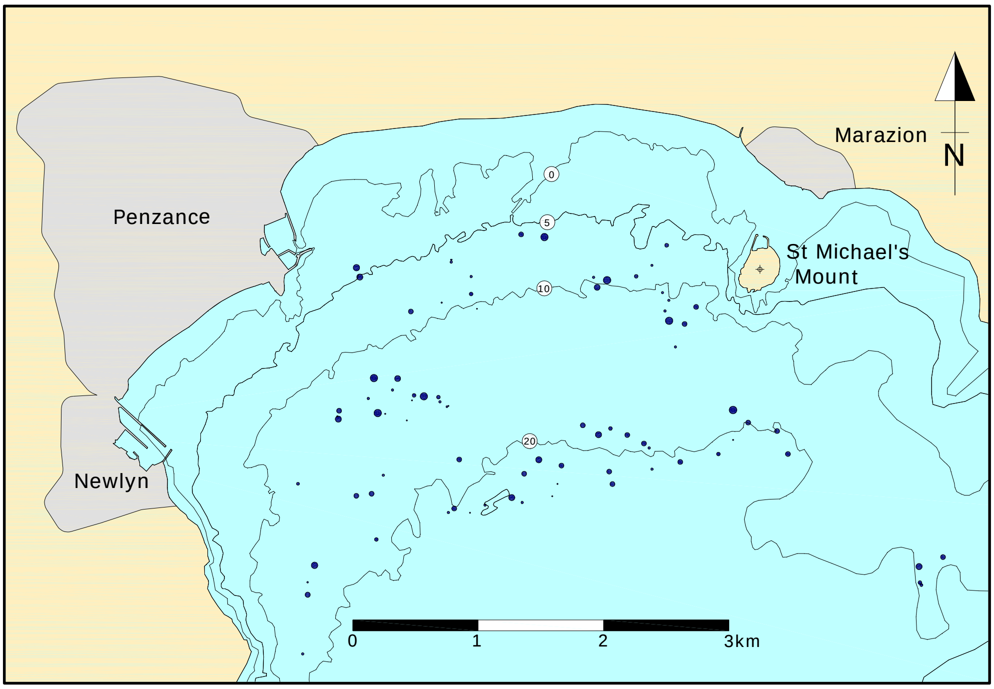


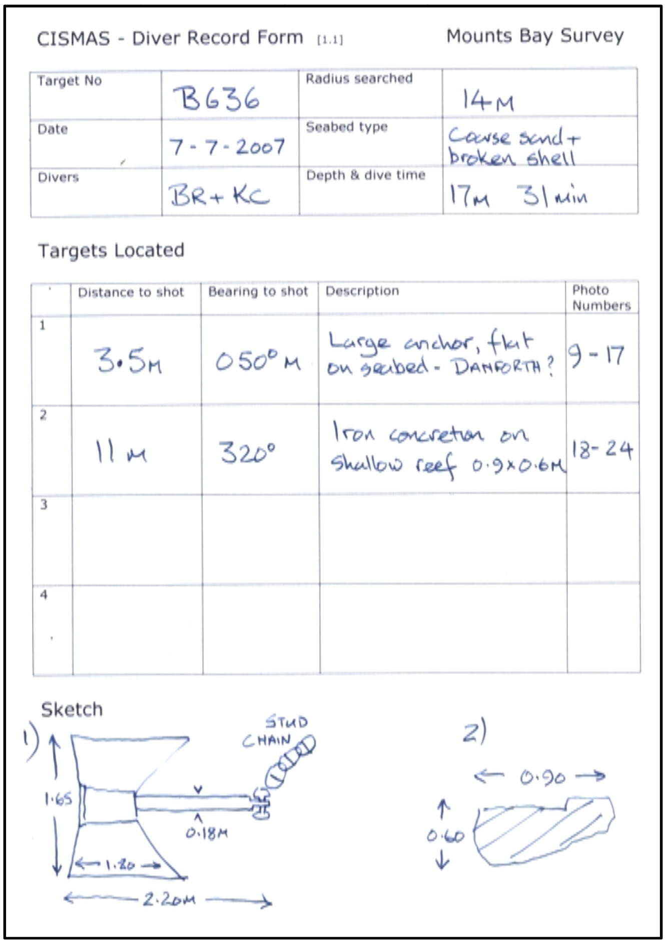
Fig 33

The distribution of circular searches performed during the Mount's Bay Survey.

Recording

Objects found during the circular search were recorded by the divers. Underwater recording forms printed on waterproof paper were used for this. A sketch and photograph would also be made as well as recording the seabed type, vegetation and sediment. An example of a completed underwater record form is reproduced below (fig 35). At the end of each day, the information from the diver record forms was added to the computer record and to the base chart.

Fig 34 A diver recording objects found on the seabed during a circular search.



CISMAS - Diver Record Form [1.1]   Mounts Bay Survey

Target No	B636	Radius searched	14M
Date	7-7-2007	Seabed type	Coarse sand + broken shell
Divers	BR + KC	Depth & dive time	17M 31 min

Targets Located

	Distance to shot	Bearing to shot	Description	Photo Numbers
1	3.5M	050° M	Large anchor, flat on seabed - DANFORTH?	9 - 17
2	11 M	320°	Iron concretion on shallow reef 0.9x0.6M	18 - 24
3				
4				

Sketch

Fig 35 Example of a completed recording form

The position of any objects located was established using the distance from the shot, measured using the markings on the distance line, and a compass bearing taken in the direction indicated by the distance line. Using these two pieces of information, the object's position in the real world was calculated and plotted on the digital base chart. A tape measure, digital camera and scale were always carried by divers on a circular search. Objects could therefore be photographed and a measured sketch produced on the record sheet, before continuing with the circular search.

Volunteer divers were instructed to record all items which were encountered on a circular search, even those that might be considered of no archaeological interest. Rocks, if they appeared to be a prominent feature, would have position and dimensions recorded so that it could be determined whether they were likely to have generated the relevant sidescan sonar target. Divers were briefed on the estimated size of the target they were investigating and shown the relevant sidescan sonar image before they entered the water. In this way they could estimate whether the material they had encountered correlated with the geophysical target. In instances where the target material was believed to have been located, searches were often continued if opportunity allowed.

Survey results

The geophysical survey produced a total of 831 targets, of which 733 were sidescan sonar targets and 98 were magnetometer targets. It was clear that it would not be possible to investigate all these targets. Accordingly the targets were sorted, with those which looked most like wreckage given the highest priority. Once targets had been dived and identified we were able to refine our target identification. For example, anchors give a very distinctive sidescan sonar image and are relatively easy to identify. However, groups of small rocks sitting on sand or silt often look remarkably like wreckage. Hence the large number of targets investigated which proved to be groups of rocks. In total 85 targets were investigated by the dive team. The results of these dives are summarized in the table below.

Fig 37

Summary of diver searches

Search Result	2006	2007	2008	Total
Anchors	0	7	1	8
Debris	2	2	4	8
Wreck	3	1	2	6
Fishing gear	2	15	1	18
Rocks	1	20	9	30
Nothing found	1	11	2	14
Total				85

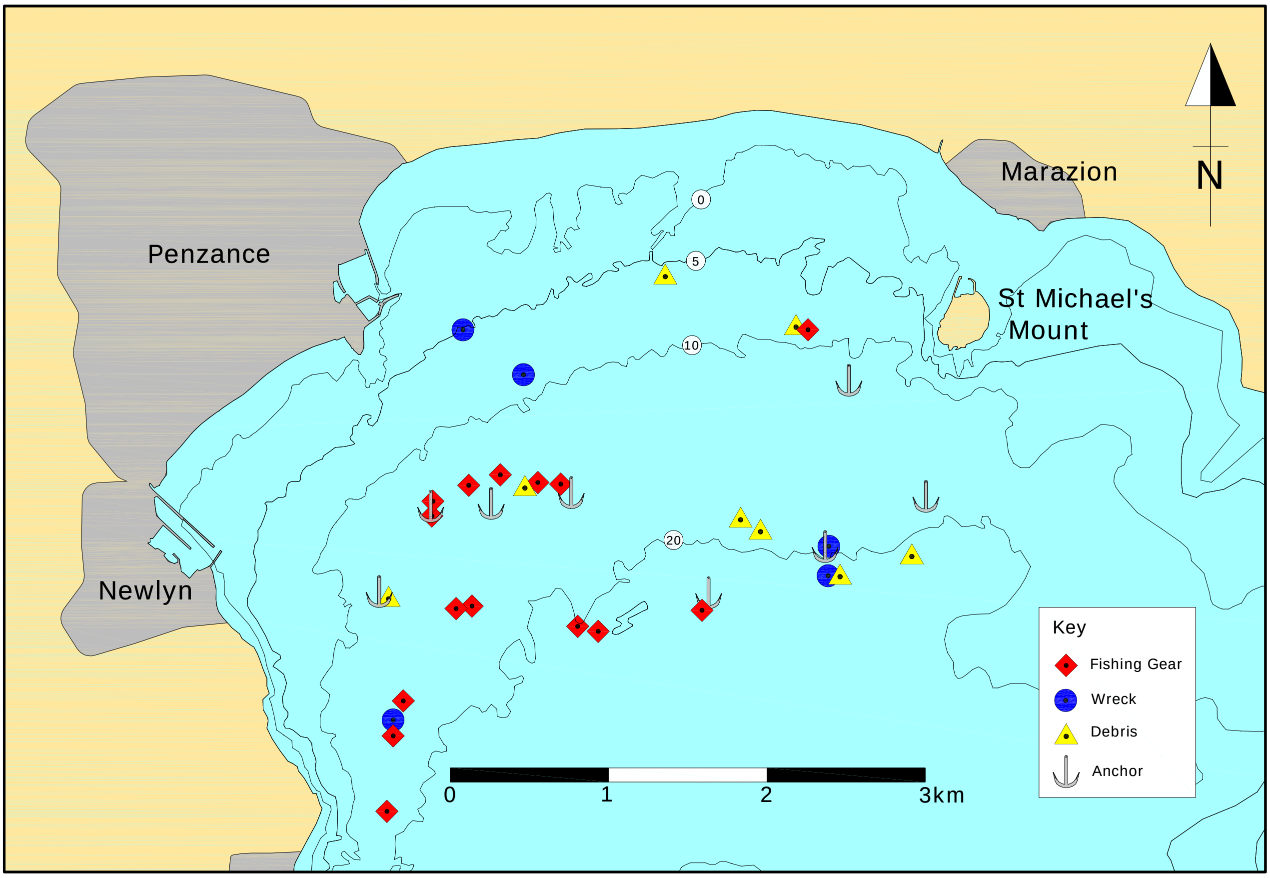


Fig 36 Distribution of objects found, grouped by object type

Target #	SScan	Mag.	Search Area	Identity	Depth	Dives	Date
15-M1-14944		X	S0407 - BG	Reef	24m	GR	03/07/2007
15-M1-15843		X	S0407 - BG	Reef	24m	BR & IM	03/07/2007
15-M5-8092		X	S0407 - BG	Nothing found	21m	KC	08/07/2007
15-M7-9833		X	S0407 - BG	Nothing found	21m	KC	08/07/2007
A324	X		NS1	Fe wreckage	18m	KC	18/11/2006
A360	X		NS1	Trawl wire & Fe concretion	18m	KC & H?	22/04/2007
A422	X		S0407 - 2	Trawl net	23m	KC	03/07/2007
A569	X		SA2	Stockless anchor	25m	BR & M?	02/07/2007
A695	X		SA2	Reef	15m	BR & M?	02/07/2007
A806	X		SA2	Rock	15m	TP & PR	30/06/2008
A807	X		SA2	Steel wreck (HMS Royalo)	14m	IM & SC	30/06/2008
A826	X		SA3	Trawl wire	19m	LR & PM	03/07/2008
A830	X		SA3	Rock	17m	PB & TB	03/07/2008
B001	X		Fri 25	Trawl wire & Fe concretion	17m	KC & H?	22/04/2007
B005	X		Fri 25	Rock in scour pit (same as B454)	19m	IM & PM	08/07/2007
B011	X		Fri 25	Rocks	23m	IM & KM	22/04/2007
B016	X		Fri 25	Round crown anchor	17m	BR & M?	21/04/2007
B018	X		Tue22	Section of steel tube mast	19m	BR & H?	14/04/2007
B019	X		Fri 25	Fe concretion	18m	KC?	24/08/2006
B019b	X		Fri 25	Nothing found	18m	BB	24/08/2006
B028	X		Tue22	Nothing found	26m	KC	07/09/2006
B030	X		Tue22	Nothing found	24m	BB	22/05/2007
B032	X		S0407 - 2	Nothing found	25m	BB	22/05/2007
B036	X		Tue22	Fe concretion - chain	24m	TH	07/09/2006
B043	X		SA3	Reef	22m	BB	07/09/2006
B071	X		Fri 25	Nothing found	25m	BR & IM	06/07/2007
B072	X		Fri 25	Boulder	17m	BB	07/09/2006
B075	X		Fri 25	Nothing found	18m	BB	07/09/2006
B084	X		Fri 25	Fe pipe	17m	BB	24/05/2007
B215	X		NS1	Nothing found	17m	M? & H?	22/04/2007
B238	X		NS1	Nothing found	19m	BR & AE	22/04/2007
B319	X		NS1	Steel hawser	16m	KD & PD	05/07/2007
B322	X		NS1	Trawl wire	17m	BR & MA	18/11/2006
B346	X		NS1	Trawl wire	17m	BR & AE	22/04/2007
B348	X		NS1	Trawl wire, net & timber fragments	17m	BR & M?	22/04/2007
B349	X		NS1	Trawl wire & Fe concretion	16m	KC & H?	22/04/2007
B354	X		NS1	Trawl wire	20m	HT & RS	14/04/2007
B357	X		NS1	Nothing found	21m	KC?	14/04/2007
B359	X		NS1	Bomb or parachute mine	16m	IM & KM	22/04/2007
B373	X		NS1	Reef	19m	BB	22/05/2007
B374	X		NS1	Steel hawser	19m	KC	05/07/2007
B377	X		NS3	Angle iron anchor and length of chain	17m	BR & S?	21/04/2007
B406	X		S0407 - 2	Steel hawser	20m	GR	03/07/2007
B429	X		S0407 - 2	Trawl net	19m	KC	03/07/2007

Target #	SScan	Mag.	Search Area	Identity	Depth	Dives	Date
B452	X		S0407 - 2	Nothing found	25m	KD & PD	06/07/2007
B454	X		S0407 - 2	Rock in scour pit	25m	IM & PM	08/07/2007
B462	X		S0407 - 2	Trawl net	20m	BR & IM	03/07/2007
B481	X		S0407 - 2	Anchor	24m	IM & TP?	19/07/2007
B485	X		S0407 - 2	Rocks	25m	KC	06/07/2007
B530	X		S0407 - 3	Rocks	23m	KM & PB	07/07/2007
B563	X		S0407 - 3	Trawl net	26m	GA & CL	06/07/2007
B568	X		S0407 - 3	Rock	26m	BR & IM	05/07/2007
B570	X		S0407 - 3	Fishing gear	24m	KD & PD	05/07/2007
B572	X		S0407 - 3	Rocks	24m	KC & GA	02/07/2007
B584	X		S0407 - 3	Reef	26m	KM	08/07/2007
B586	X		S0407 - 3	Rocks	26m	IM & PM	07/07/2007
B602	X		S0407 - 3	Steel hawser and trawl net	27m	KC	05/07/2007
B607	X		S0407 - 3	Rocks	16m	KM & PB	07/07/2007
B618	X		S0407 - 1	Rocks	19m	IM & PM	08/07/2007
B624	X		S0407 - 1	Stockless anchor	16m	BR & IM	05/07/2007
B626	X		S0407 - 1	Rocks (same as B634)	18m	KM	08/07/2007
B633	X		S0407 - 1	Stockless anchor	21m	KC	07/07/2007
B634	X		S0407 - 1	Rocks	23m	KM	08/07/2007
B636	X		S0407 - 1	Stockless anchor	20m	KC	07/07/2007
B639	X		S0407 - 1	Rocks (same as B618)	19m	IM & PM	08/07/2007
B644	X		S0407 - 1	Stockless anchor (same as B633)	19m	IM & PM	07/07/2007
B655	X		NS4	Reef	17m	JB	31/07/2007
B658	X		NS4	Reef	14m	KC & GA	02/07/2007
B678	X		NS4	Rocks	14m	JB	31/07/2007
B696	X		NS4	Reef	12m	KC	31/07/2007
B801	X		SA2	Fe angle & lobster Pot	16m	KC & LR	30/06/2008
B802	X		SA2	Reef	16m	SC & PB	01/07/2008
B803	X		SA2	Nothing found	12m	SC & PH	03/07/2008
B809	X		SA2	Rocks	11m	IM & SC	30/06/2008
B811	X		SA2	Reef	15m	TP & PR	30/06/2008
B818	X		SA2	Reef	15m	IM & PB	02/07/2008
B820	X		SA2	Rocks	13m	IM & SW	01/07/2008
B823	X		SA2	Rock	11m	PB & TB	03/07/2008
B825	X		SA3	Anchor	15m	SC & PH	03/07/2008
BG2-L5-51		X	BG2	Steel wreck	9m	IM & PB	02/07/2008
BG2-L5-528		X	BG2	Metal detector target	10m	KC & LR	01/07/2008
BG2-L6-716		X	BG2	Nothing found	8m	KC & LR	02/07/2008
C813	X		SA2	Rock	15m	KC & LR	30/06/2008
H1247	X		SA3	Lobster pots	19m	TH	07/09/2006
H1253	X		SA3	Small section of Fe wreck	17m	BB	07/09/2006
SA1-L6-758		X	SA1	Metal detector target	9m	LR & PM	03/07/2008
SA1-L7-350		X	SA1	Metal detector target	14m	KC & LR	01/07/2008

Fig 38 Table of targets investigated.

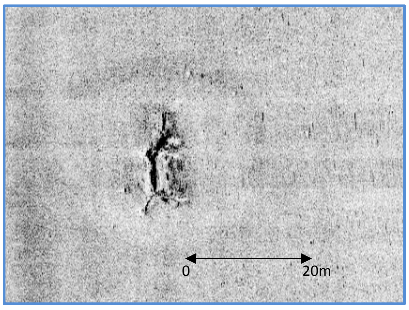
Wreck

There are almost a hundred wrecks listed in Mount's Bay in the United Kingdom Hydrographic Office (UKHO) data base, the majority of them losses from the nineteenth and twentieth centuries. The primary aim of our survey was to locate new wrecks. However, where known wrecks were encountered these were surveyed. The following are the more noteworthy of these surveys – some of which consist of sidescan sonar images only.

Fig 39

Sidescan sonar image target B0022

Target No	B022
Position	321966E 5553184N
Chart depth	19m
Vessel name	Unknown
Vessel type	Composite sail
Built	1860-80
Length	>16m
Tonnage	Unknown
Wrecked	1884-88?



The wreck of a small sailing vessel was located less than 200m from the known wreck of the Alice Marie. The wreck of the Alice Marie is one of the most popular dive sites in the bay. It is remarkable that this small wreck had not been discovered by any of the hundreds of divers visiting the site of the Alice Marie. It was clear that this site had not been previously visited from the wealth of material lying undisturbed on the seabed, including the ships bell, a maker's plate and numerous other small objects.

The remains of this vessel are partly buried in the silty sand of the seabed. What remains above the seabed consists of a small donkey boiler, a steam powered capstan, a small anchor, a mound of cast iron blocks, ballast stones and part of the ship's hull. The exposed hull consists of inner and outer timber planking, fastened over wrought iron frames. This type of construction, known as composite construction, is interesting for a number of reasons. Composite ships were only made for a relatively short period of time between 1860 and 1880. This type of construction is best known because it was used for the tea clippers, such as the Cutty Sark. Using wood instead of iron for the outer hull allowed the use of copper sheathing, which helped prevent the ship's hull becoming foul with weed and barnacles and meant the ship could sail faster. The use of iron frames instead of wood meant the ship was stronger and able to resist hogging and sagging, a common problem with wooden-framed ships (McCarthy, 2005: 118-121).

The surviving timber of the vessel's hull is in remarkably good condition, probably due to its burial beneath the fine silty sand of the seabed in this part of the bay. The timber appears to be a yellow, resinous softwood, possibly yellow pine. The remains of chain plates (the attachments of the shrouds which support the mast) attest to this being a sailing vessel. The presence of the small upright donkey boiler is more unusual. The vessel could theoretically have had auxiliary steam propulsion – however, no such engine has been found. What has been found is a steam powered capstan, so given the very small size of the upright boiler it seems more likely that the vessel had steam power to operate the capstan and possibly other devices such as a winch (Paasch, 1997).

The central part of the wreck is occupied by a collection of large, water-smoothed stones. These are probably part of the ballast of the vessel. On top of these ballast stones there are a number of large, square cast-iron blocks, each of about 25kg weight . These could either be part of the ship's cargo or they could be ballast. It is possible to see where the ballast stones and cast iron blocks were stacked against a timber bulkhead within the hold, which has now rotted away

Fig 40

Diver and donkey boiler

This wreck was surveyed using a single baseline fixed between two control points. The wreckage was drawn by a team of four divers using planning frames and by using offset measurements.

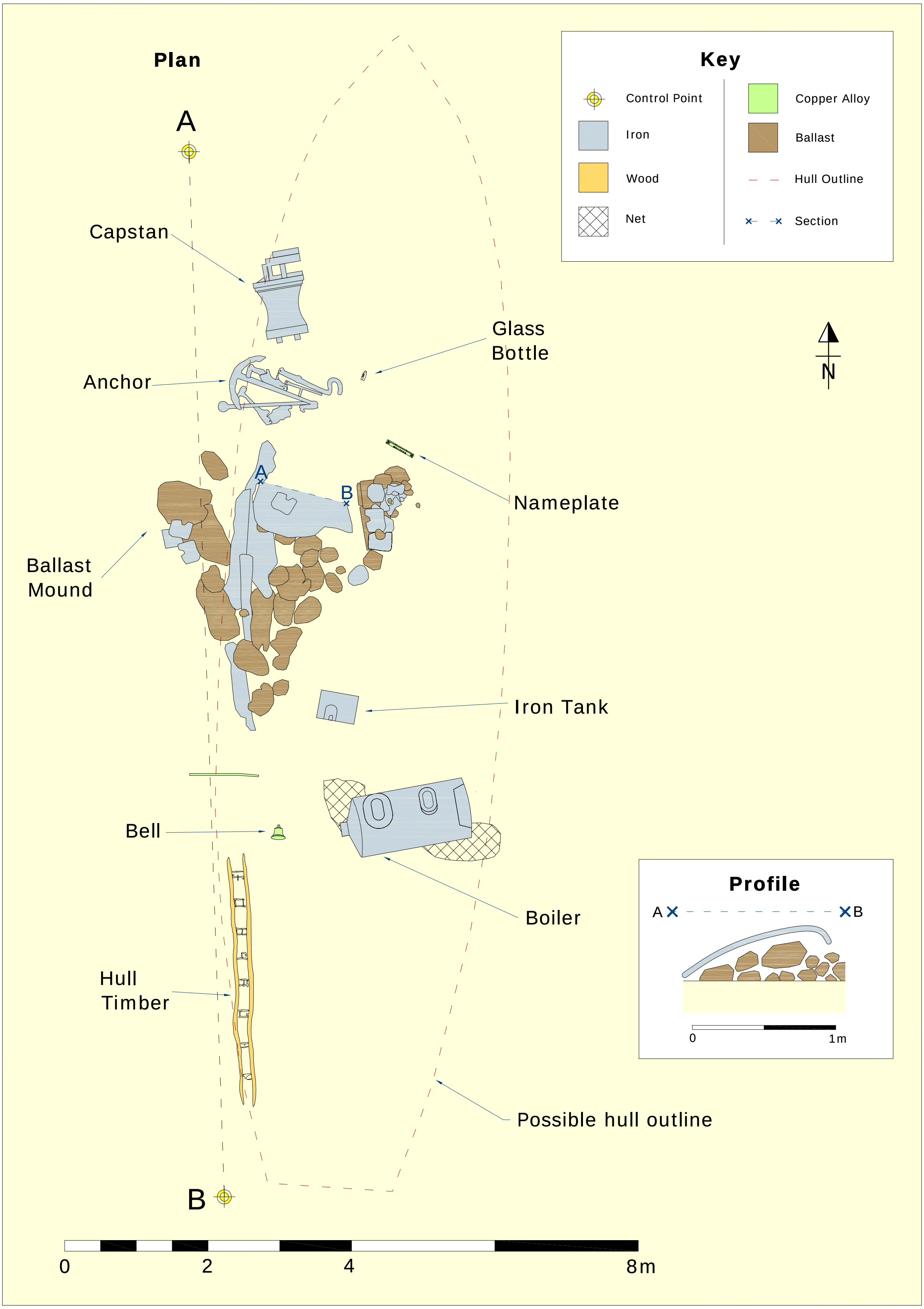


Fig 41 Outline survey of small composite sailing vessel B022

Fig 42

Donkey boiler

Fig 43

Anchor and capstan

Fig 44

Iron ballast blocks

B022 finds

The ship's bell was found lying on the seabed close to the donkey boiler (see fig 45). The bell did not carry any inscription – ship's bells often have the name of the vessel and date of construction on them. Bells were used to sound the time of day to regulate the crew's watches. The bell was struck every half hour, from one bell to eight bells, thus marking the passage of a four hour watch. They were also used as warning devices when the vessel was in fog.

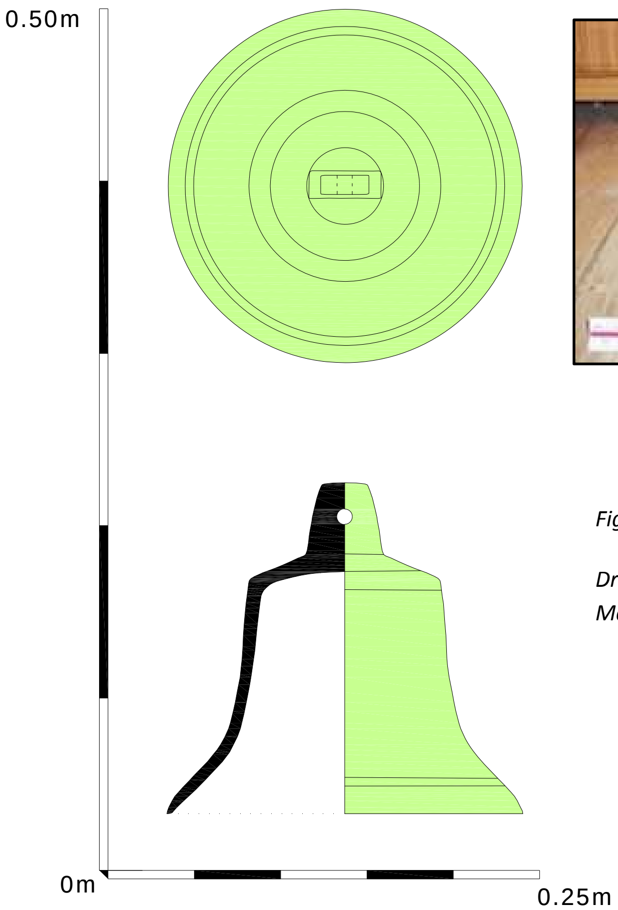


Fig 45 The bell found on the wreck

Drawing by Brendon Rowe and Kerry McFarlane

The bell appears to be made of a copper alloy, probably bronze. It does not 'ring' when struck, indicating that it is probably cracked.

A copper alloy plate bearing the legend 'Wallsend' was found on the seabed not far from the ballast mound. Clearly this is only part of the original plate. Wallsend is a place near Newcastle on Tyne and was famous for shipbuilding in the 19th century. Thus Wallsend could be the name of the ship, the place of manufacture or possibly a maker's name for machinery on board.

Fig 46

The 'Wallsend' plate

The decorative border around the top and sides of the plate demonstrate that part of the plate is now missing. To date no record of any vessel called Wallsend of this period has been found.

A glass bottle was found close to the anchor. The bottle was of the type sealed by a glass marble, often called a Codd bottle after its inventor. This is a type of bottle first patented by Hiram Codd in 1872. It used an enclosed glass marble in the neck to form a seal and was mainly used for fizzy drinks including mineral water and lemonade. The Codd bottle found on this wreck bears the name of the Newlyn and Gulval Ice Works Company. This company was situated near Penzance and is listed in the 1872 Kelly's Directory for Cornwall as manufacturers of aerated waters. The bottle also bears a maker's name of Dan Ryland (see fig 47) which only appears in this form between 1884-88 (Pike, W, T, 1898: 45-46).

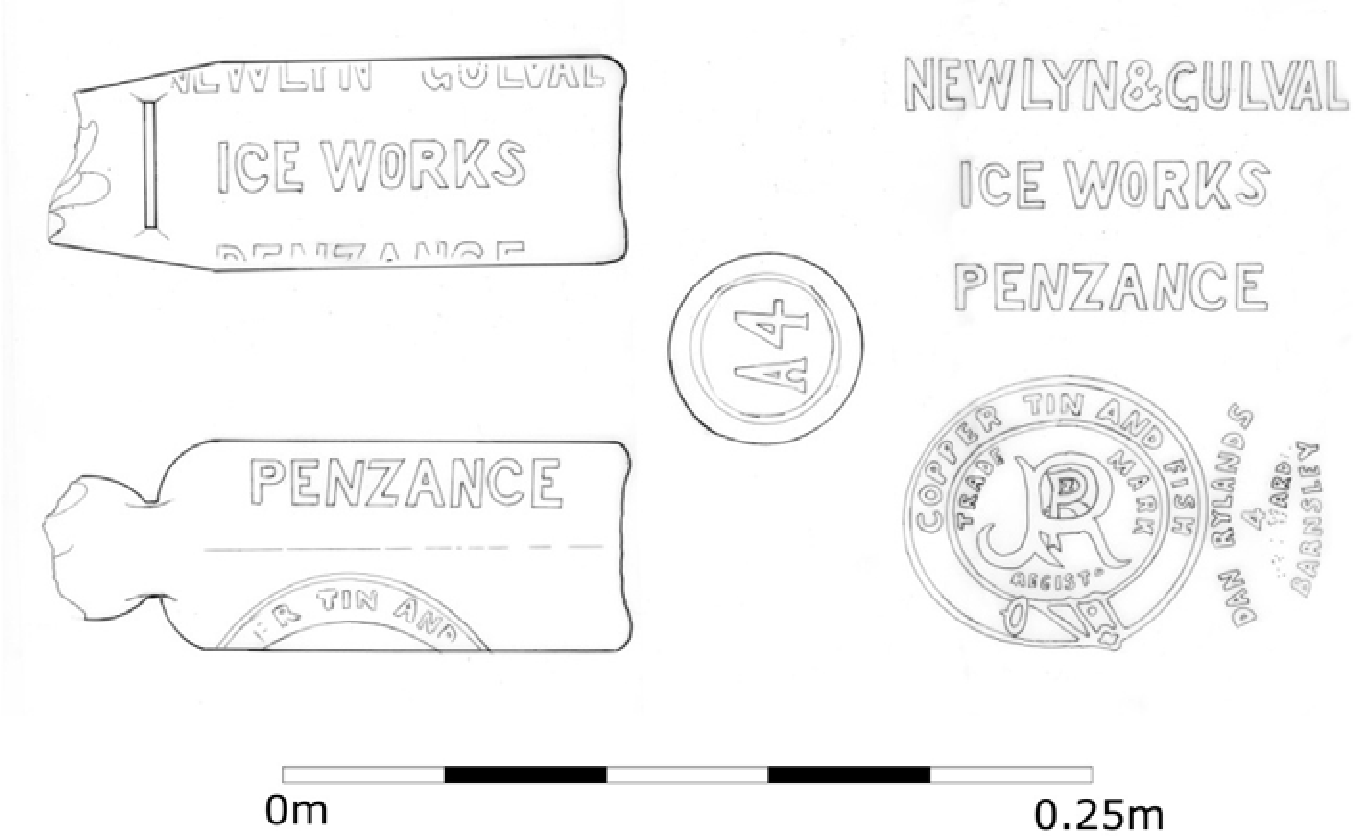


Fig 47 The Codd bottle – drawing by Janet Witheridge

We cannot be certain that this bottle was aboard the vessel when it sank – it could have been deposited on the site separately. However the date of this bottle accords well with the date of the vessel as indicated by its construction details (1860-80). If the bottle was on board then it probably indicates that this vessel called at one of the local ports, possibly even Penzance

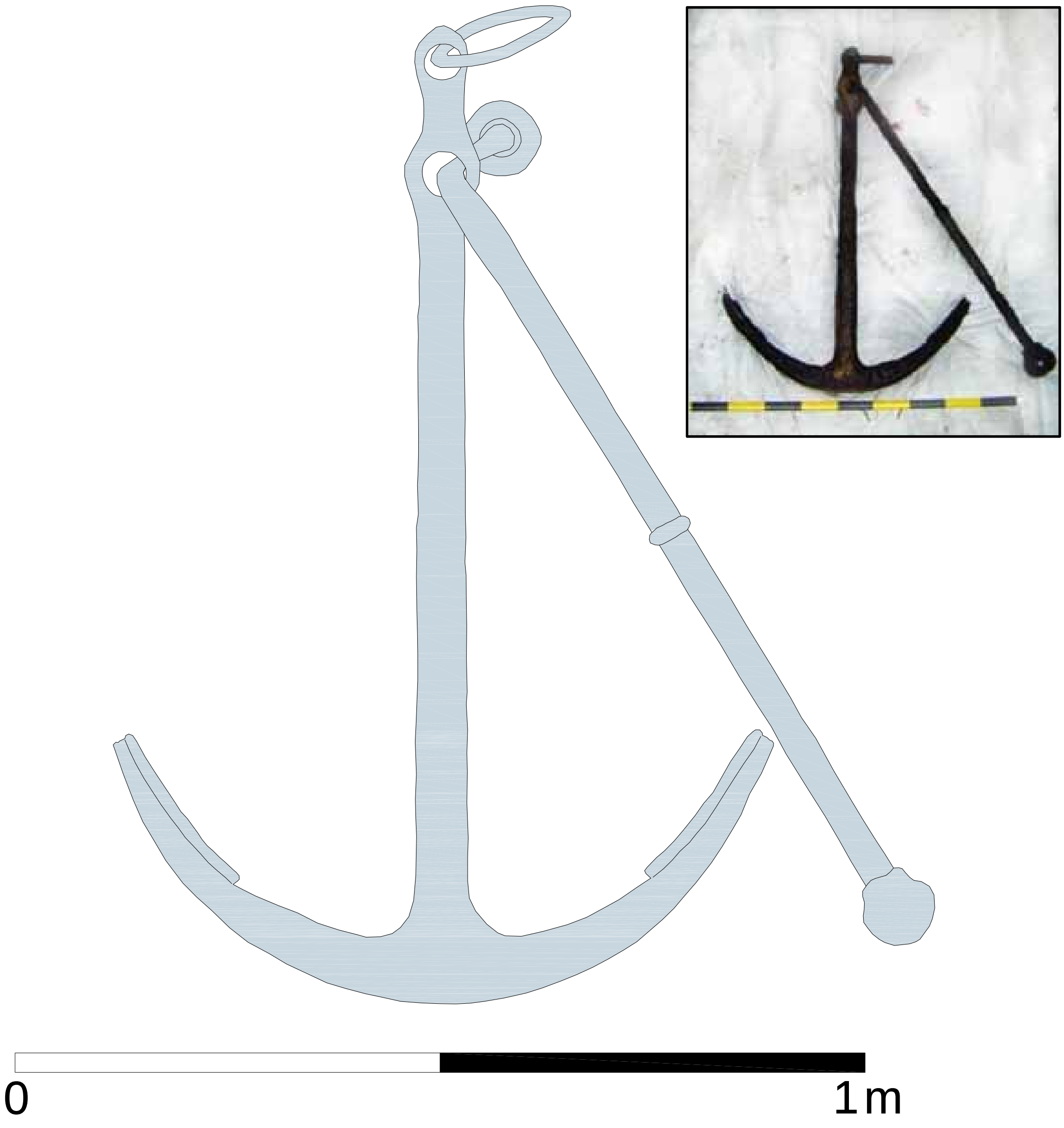
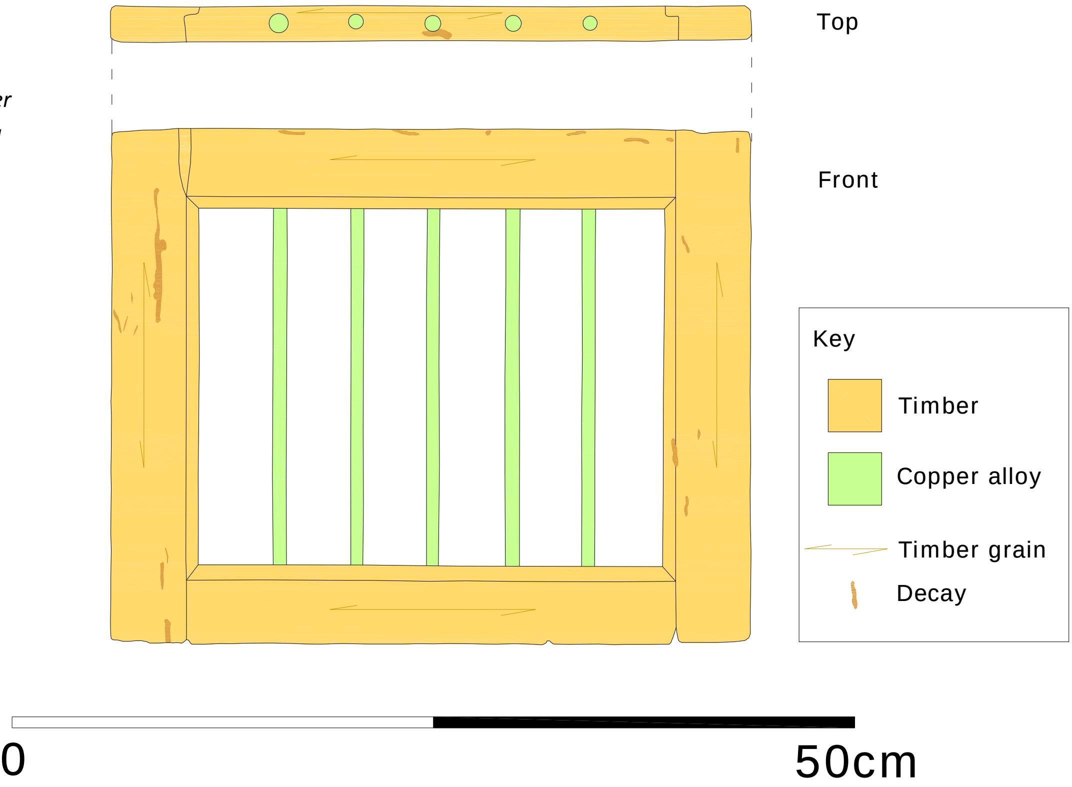


Fig 48 The round crown anchor with folding iron stock. This anchor is the only one found to date on the wreck, but is unlikely to be the only anchor the vessel carried. Drawn by Brendon Rowe

Fig 49

A wooden frame with copper alloy bars, possibly part of a cabin door. Drawn by Brendon Rowe

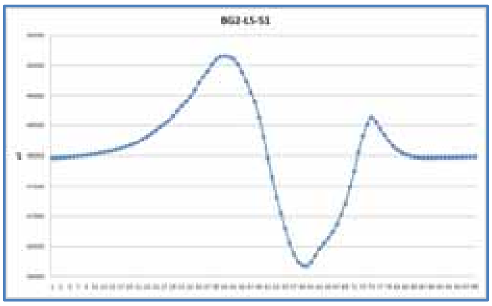


We do not know the name of this wreck or how it came to be wrecked. We can conclude that this vessel was built between 1860 and 1880, and was at least 16m (60ft) in length. The hull was of composite construction (pine planking fixed to iron frames), and the vessel was a sailing ship with auxiliary steam power, probably to power the capstan and winches. Hopefully further work on this wreck will help us to identify the vessel.

Fig 50

Series graph of magnetometer readings for target BG2-L5-51

Target No	BG2-L5-51
Position	319666E 5554548N
Chart depth	6m
Vessel name	Antwerpen
Vessel type	Iron steamship
Built	1887
Length	80m
Tonnage	1637
Wrecked	20th Nov 1917



The Antwerpen was on route from Barry to Rouen with a cargo of coal when she was torpedoed by UC 77 south of the Runnel Stone. The crew abandoned ship but she did not sink and was later towed by tugs to Penzance. Very little of the vessel now remains on the seabed and it is mostly covered by sand. The small exposed section of the wreck was surveyed and the outline plan is shown below. The magnetic anomaly for this target was a 3500 nT dipole when plotted as a series graph (see above), which gives a predicted mass of approximately 200 tonnes of iron

Fig 51

Outline survey of the exposed remains of the steamship Antwerpen

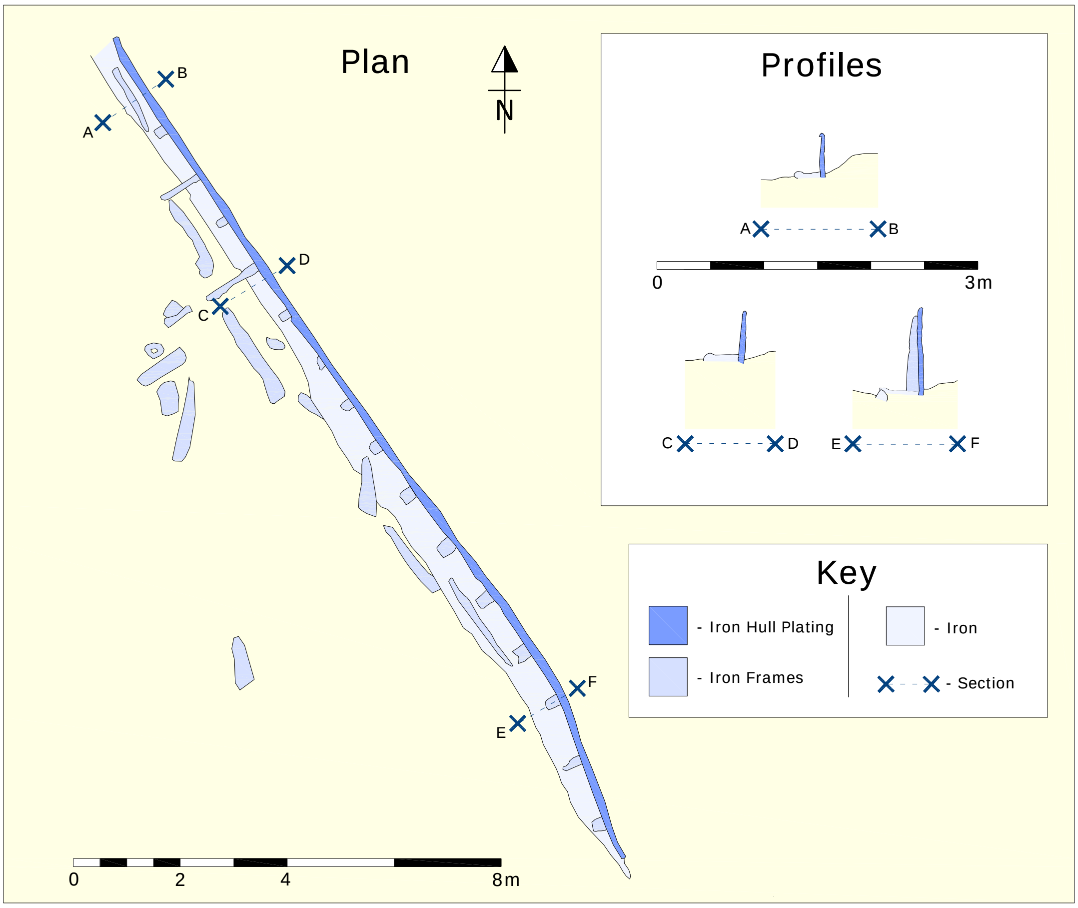
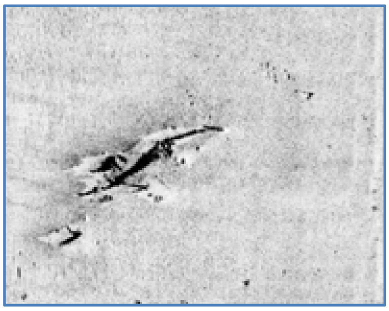


Fig 52

Sidescan sonar image of target A807, the remains of the Royalo

Target No	A807
Position	320072E 5554272N
Chart depth	8m
Vessel name	Royalo
Vessel type	Steam trawler
Built	1916
Length	36m
Tonnage	248
Wrecked	1st Sept 1940



Built as a steam trawler, the Royalo was commissioned by the admiralty during WW2 as an auxiliary patrol vessel. She was working as a minesweeper when she hit a magnetic mine and sank near the entrance to Penzance harbour in 1940. The Royal Navy cleared the wreck using explosives in the 1960's. A surprising amount of wreckage remains on the seabed, but much of it is buried under sand.

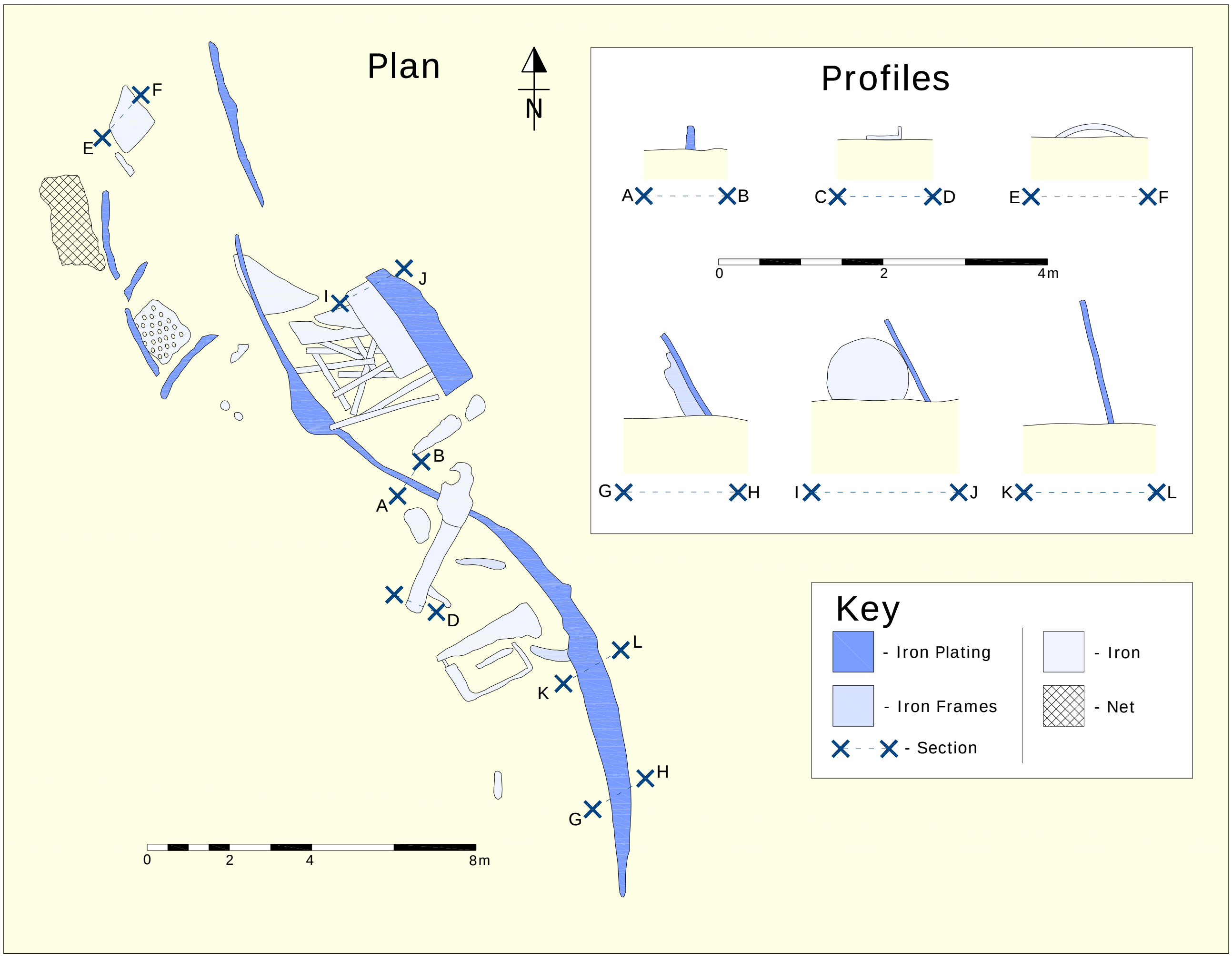
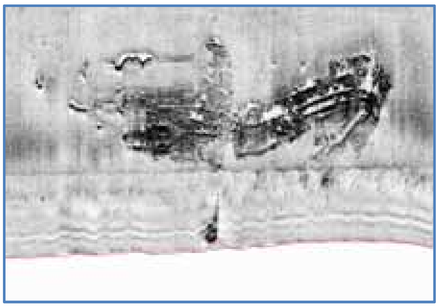


Fig 53 Outline survey of the exposed remains of the wreck of the Royalo. Note the similarity of the outline plan to the Sidescan sonar image.

Fig 54

Sidescan sonar image of target A807, the remains of the Alice Marie

Target No	190806-T4
Position	321962E 5553010N
Chart depth	32m
Vessel name	Alice Marie
Vessel type	Iron sail barque
Built	1901
Length	84.2m
Tonnage	2181
Wrecked	4th Oct 1908



The Alice Marie was a French iron sailing barque on voyage from Liverpool to Antwerp in ballast when lost. She hit the Runnel Stone in fog, but was successfully refloated by tug. She headed for Penzance but sank just south of St Michael's Mount. The crew landed safely in Penzance. The wreck was dispersed by Trinity House in 1909 and was heavily salvaged. The wreck lies in 25m of water and is now very broken up, but despite this it is a popular dive site.

Target No	1104-L5
Position	321581E 555009N
Chart depth	35m
Vessel name	Hellopes
Vessel type	Iron steamship
Built	1889
Length	97.6m
Tonnage	2774
Wrecked	29th Dec 1911

The Hellopes was an iron steamship and one of the largest of the known wrecks in the bay. The Hellopes was on her last voyage when wrecked. She was carrying coal from the Mersey to Falmouth, where she was to be broken up. She developed a list when her cargo shifted in a severe gale and entered Mount's Bay almost on her beam ends. The Hellopes sank within three miles of Penzance in 30m of water (Larn, 1995). Today the wreck is a popular dive site, and the vessel lies upright on the seabed with the cargo of coal still in her holds. The sidescan sonar image of the wreck is shown in (fig 55). Details of the vessel can be seen on the sidescan image, where the boilers, engine and holds are all clearly visible. The length of the wreck as determined from the sidescan image is 98m, which accords extremely well with the vessel's recorded length. Note the sonar shadows which indicate the upstanding parts of the wreck, particularly the stern.

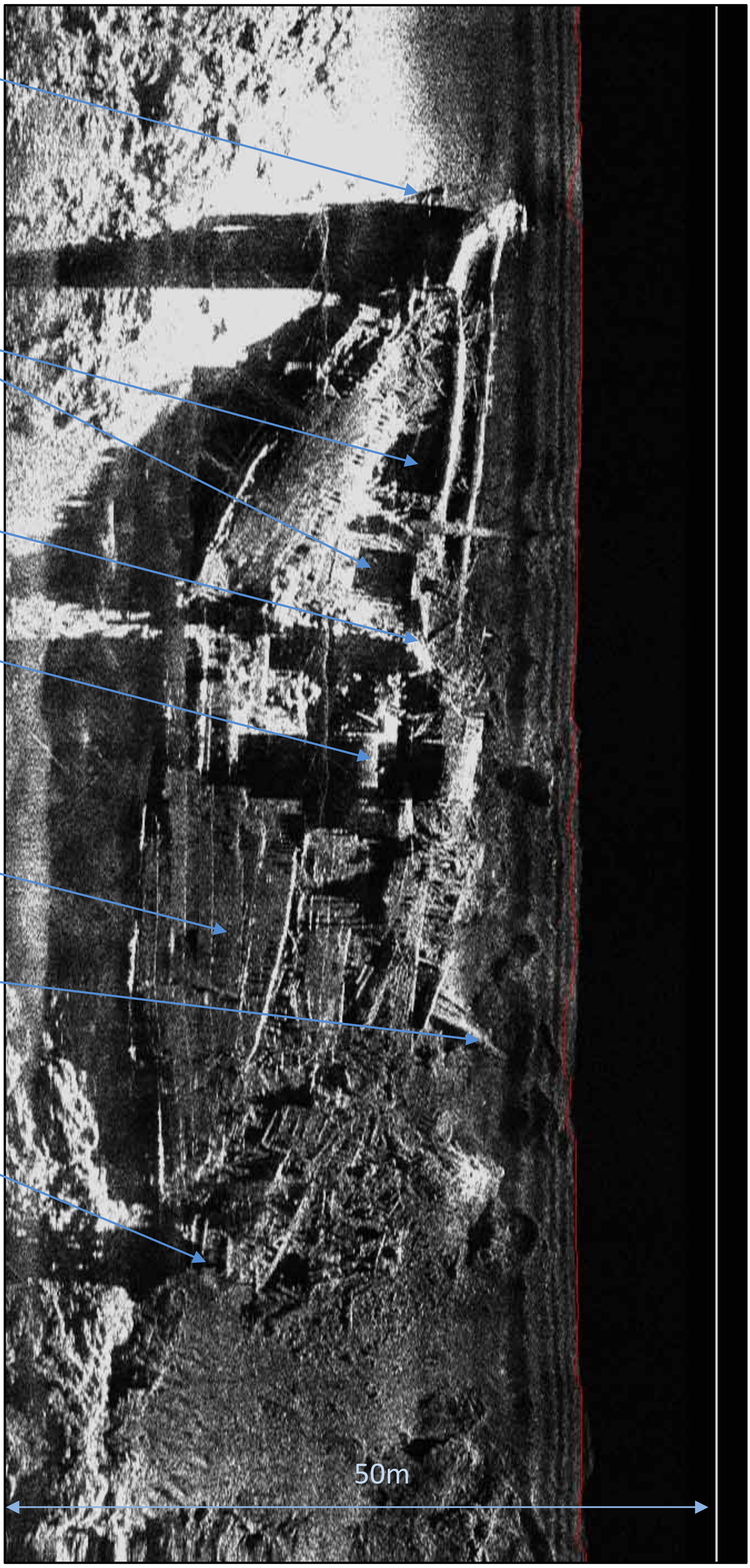


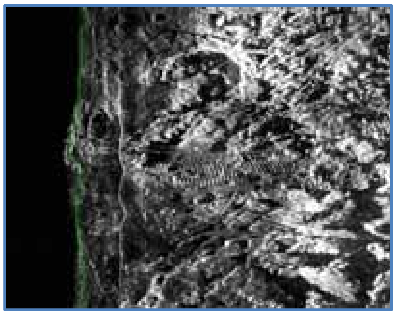
Fig 55

Sidescan sonar image of the iron steamship Hellopes

Fig 56

Sidescan sonar image of target 1007-L3, the remains of Lincoln

Target No	1007-L3
Position	314321E 5547023N
Chart depth	30m
Vessel name	Lincoln
Vessel type	Iron steamship
Built	1865
Length	60m
Tonnage	524
Wrecked	5th July 1886

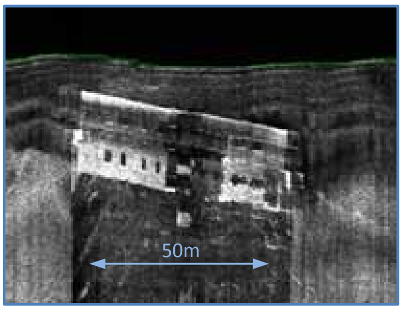


The Lincoln was on a voyage from Cardiff to Plymouth with a cargo of coal when she hit the Runnel Stone. The vessel then sank off Boskanna Bay, to the west of the Bucks Reef. The captain and crew landed in small boats at Penzance. The remains of this wreck are in 30m of water and are very broken up.

Fig 57

Sidescan sonar image of target 1007-M01, the remains of a Mulberry Phoenix Unit

Target No	1007-M01
Position	320276E 5546487N
Chart depth	49m
Vessel name	Phoenix 203
Vessel type	Mulberry
Built	1944?
Length	60m
Tonnage	?
Wrecked	25th Sept 1944

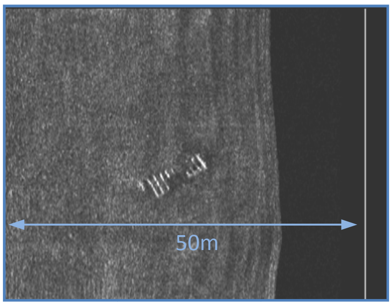


This is known locally as 'The Mulberry Harbour'. It consists of a large steel-reinforced concrete box sat on the seabed in over 50m of water. Observation of the wreckage indicates that this was indeed an element of the Mulberry floating harbours, which were used in the D-Day landings in June 1944. Specifically, this is probably a Phoenix unit. The Phoenix units were large concrete caissons (c. 60m long, 18m high) which were large concrete boxes open at the bottom which could be lowered to the seabed and later refloated. They were built in Britain and towed over to France by tugs. How this particular Phoenix unit came to be sunk in Mount's Bay is not known. Furthermore, the UKHO record for this wreck states that it sank in September 1944, a date somewhat later than the D-Day landings for which such units were intended. Records (marked secret) at the Public Records Office (PRO) state that *AX Phoenix 202 and APD 203 were lost due to leaking ports in transit* (WO 219/952). But no details of where it was heading or exactly when it sank are given.

Fig 58

Sidescan sonar image of target A837, part of an iron vessel

Target No	A837
Position	319248E 5552113N
Chart depth	20m
Vessel name	Unknown
Vessel type	Iron
Built	19th century
Length	?
Tonnage	?
Wrecked	?



This piece of wreck produced a very distinctive sidescan sonar target. On investigation this was found to be a small section of an iron ship in 20m of water. The wreckage consists of a section of hull plating 6.2m x 2.1m lying flat on the seabed. The iron is in an advanced state of corrosion, consistent with the wreckage being submerged for a considerable time. The hull plating has a number of iron ribs, which are attached to the hull plating with iron rivets. There is no other iron debris in the vicinity, so it is hard to account for this isolated piece of wreck. The most likely explanation is that this was deliberately dumped, probably from a 19th century vessel.

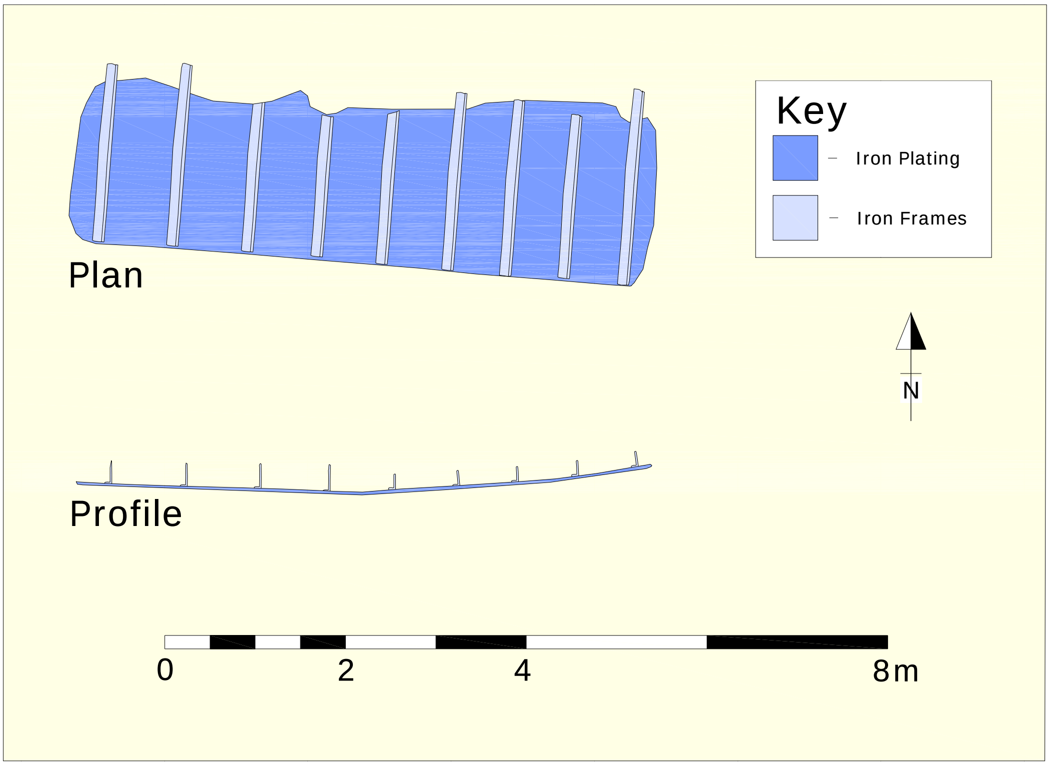


Fig 59 Outline survey of target A837 - a section of an iron vessel

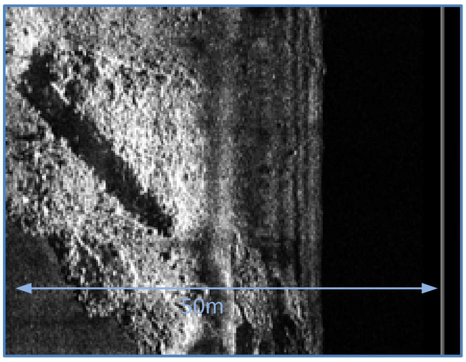
Anchors

Mounts Bay is used today as an anchorage for ships sheltering from severe weather; this would also have been true in historic times. A total of eight anchors were located by the survey. They ranged in date from the early 19th century to the present day. It is perhaps noteworthy that no earlier anchors were located. This could be because earlier vessels anchored further inshore or that the older anchors are no longer visible on the seabed, having sunk into the soft sediments prevalent in much of the bay. These will have registered as magnetic targets, but no intrusive investigation was undertaken as part of this survey.

Fig 60

Sidescan sonar image of round-crown anchor B016

Target	B016
Position	322641E 5553485N
Anchor type	Round-crown
Shank Length	2.20m
Estimated date	19th C
Water depth	17m

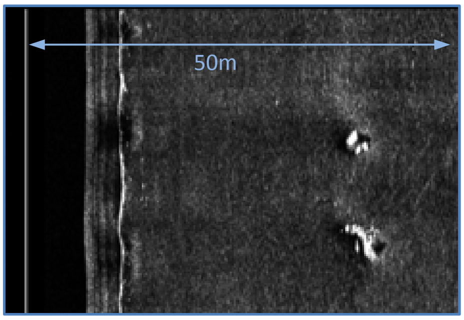


This is a round-crown anchor, a type often referred to as an Admiralty pattern anchor. This style of anchor replaced the older style angle-crown anchor in the early 19th century. The anchor was found with one fluke still buried in the seabed.

Fig 61

Sidescan sonar image target B377

Target	B377
Position	322196E 5554176N
Anchor type	Fisherman's
Shank Length	<2m
Estimated date	Late 20th century
Water depth	17m



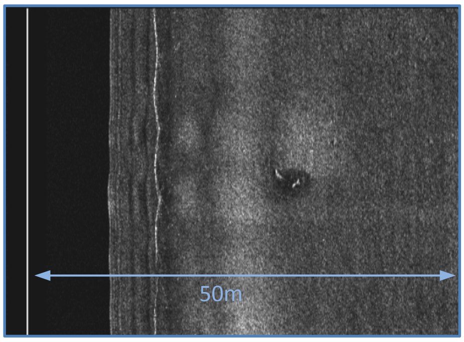
A modern anchor and chain. The anchor was constructed from angle iron, probably home made. Possibly used as an anchor for fishing gear

.

Fig 62

Sidescan sonar image of anchor B481

Target	B481
Position	321973E 5553109N
Anchor type	Stockless
Shank Length	3.50m
Estimated date	Post 1820
Water depth	24m

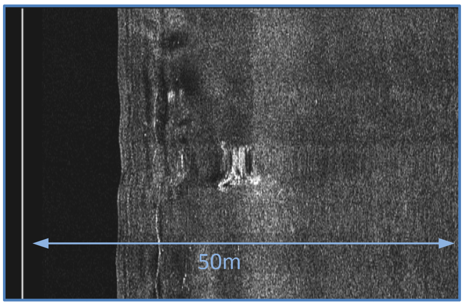


Large stockless anchor, partly buried in the seabed. The flukes of the anchor were buried, preventing a more precise identification of the anchor type. However, stockless anchors were not invented until the early part of the nineteenth century (Curryer, 1999). Probably from a large iron vessel anchored in the bay which failed to recover its anchor.

Fig 63

Sidescan sonar image of anchor A569

Target	A569
Position	321241E 5552795N
Anchor type	Stockless
Shank Length	2.65m
Estimated date	Late 19th - 20th C
Water depth	25m

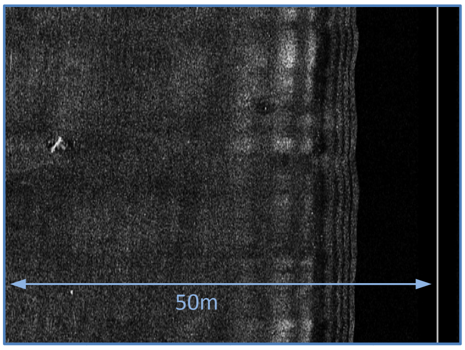


A large stockless anchor and chain, lying flat on the seabed. The anchor is of the close stowing type with the flukes attached to the stock by a swivel mechanism (Curryer, 1999: 119).

Fig 64

Sidescan sonar image of anchor B624

Target	B624
Position	319868E 5553454N
Anchor type	Dreadnought
Shank Length	>2.40m
Estimated date	Early 20th C
Water depth	16m

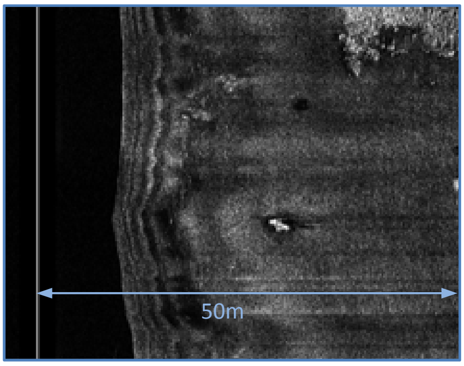


A large stockless anchor partly buried in the seabed. This anchor is of the Taylor Dreadnought type, sanctioned by Lloyd's in 1909. This was one of the most popular anchors of its period (Curryer, 1999:122).

Fig 65

Sidescan sonar image of anchor B633

Target	B633
Position	320372E 5553517N
Anchor type	Stockless
Shank Length	2.60m
Estimated date	Early 20th C
Water depth	21m

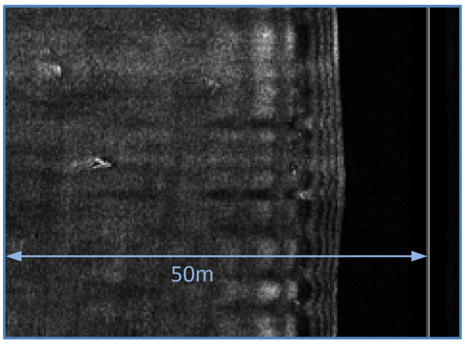


Large stockless anchor and chain lying flat on the seabed. The anchor is of the close stowing type with the flukes attached to the stock by a swivel mechanism. The anchor is covered by snagged net and fishing gear.

Fig 66

Sidescan sonar image of anchor B636

Target	B636
Position	319486E 5553434N
Anchor type	Danforth
Shank Length	2.20m
Estimated date	Late 20th C
Water depth	20m

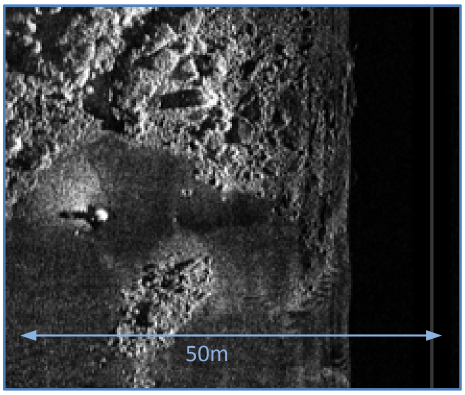


This anchor is a very large example of the Danforth type. Danforth anchors are very common as small boat anchors. The anchor is lying flat on the seabed.

Fig 67

Sidescan sonar image of anchor B825

Target	B825
Position	319230E 5552266N
Anchor type	Trotman/Porter
Shank Length	1.95m
Estimated date	Early 19^{th} C
Water depth	15m



This anchor was of medium size and of the Trotman / Porter type. It was accompanied by a short length of chain, broken at one end and still attached to the anchor at the other. The type has a distinctive palm from which the identification was made. In the early part of the nineteenth century many 'improved' anchor types were designed. The aim of these new designs was for better holding with reduced weight of anchor.

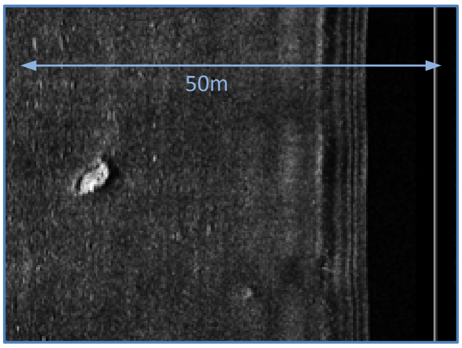
Debris

This section deals with items which are not a wreck or anchor but are still man-made. In some cases the remains may be an indication of wreck in the vicinity but the remains are not substantial enough to suggest that this is a wreck.

Fig 68

Sidescan sonar image of target B001

Target	B001
	A324
	B349
	A360
Position	320095E 5553598N
Type	Iron & concretion
Estimated date	20^{th} century
Water depth	15m

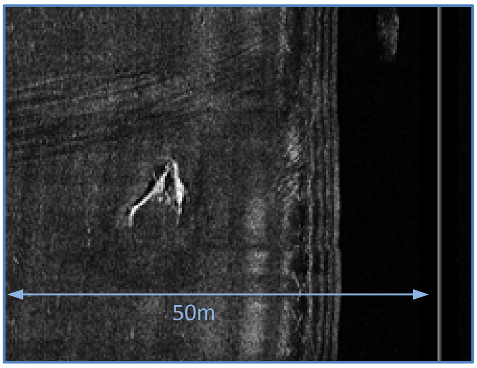


A small area of rocks about 10m x 4m surrounded by silty sand. The rocks have various items of debris amongst them, including an oval coil of steel trawl wire, small pieces of angle iron and areas of iron concretion. Most of the iron is twentieth century, including angle iron. The iron concretion is of unknown date.

Fig 69

Sidescan sonar image of target B018, probably part of the mast from the wreck of the Alice Marie

Target	B018
	B029
	B037
Position	321999E 5553010N
Type	Iron tube (mast)
Estimated date	1901
Water depth	22m

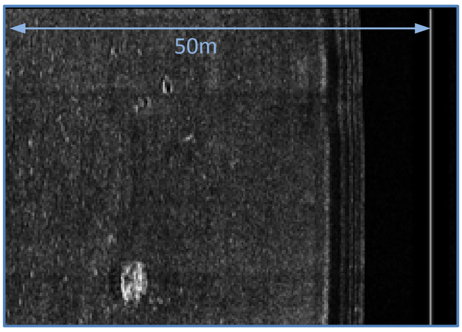


Two sections of iron tube, fabricated from iron plates riveted together. One piece is 7m long and the other 7.5m long, each being roughly 0.40m in diameter. The two pieces are still joined but lie at an angle of about 45 degrees to each other. They are laying flat on a silty sand seabed. The stern of the wreck of the Alice Marie is 36m to the west of this debris. These were probably part of the mast of the Alice Marie.

Fig 70

Sidescan sonar image of target B019

Target	B019
Position	321569E 5553287N
Type	Concretion
Estimated date	?
Water depth	18m

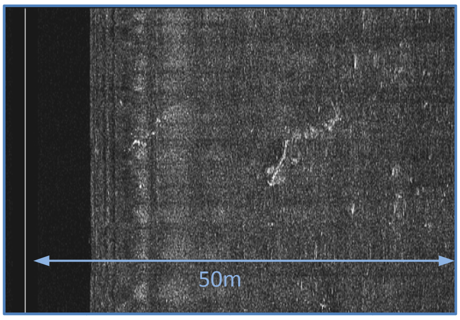


Scattered small pieces of iron concretion on a silty sand seabed. One small wrought iron nail was also seen. The hard target seen towards the bottom of the sidescan sonar image is difficult to reconcile with what was found on the seabed. Similar images to this have been observed where fishing net was found, so perhaps this was fishing net which had moved in the tide in the three weeks which passed between the sonar image capture and diving on the target.

Fig 71

Sidescan sonar image of target B036, a length of iron chain

Target	B036
Position	322525E 5553132N
Type	Iron concretion
Estimated date	19th century?
Water depth	23m

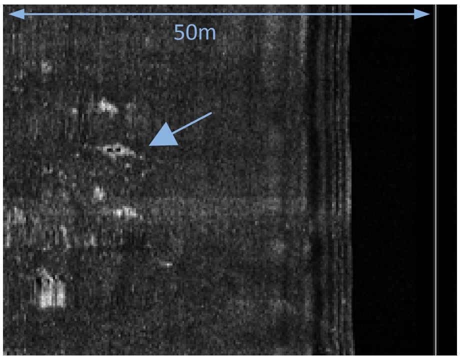


This sidescan sonar target was caused by a length of heavily concreted iron chain, partly buried in the silty sand seabed. Just over 5m of the chain is visible, but more lies buried beneath the seabed. The concretion is of variable diameter, on average 0.08m. No detail of the chain construction could be discerned due to the heavy concretion, but the amount of concretion suggests that this chain has been on the seabed for some time.

Fig 72

Sidescan sonar image of target B084 (target is indicated by the arrow)

Target	B084
Position	321443E 5553362N
Type	Iron tube
Estimated date	20th century?
Water depth	17m

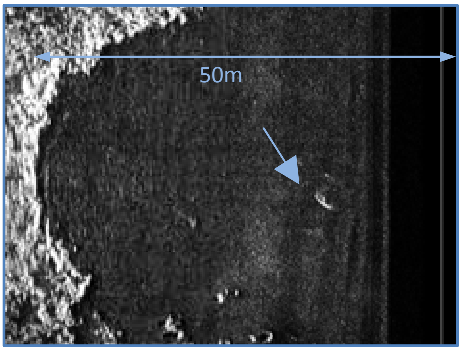


Length of iron tube 3.2m long and about 0.15m in diameter, corroded and partly flattened.

Fig 73

Sidescan sonar image of target B801

Target	B801
Position	321869E 5554554N
Type	Iron
Estimated date	20th century?
Water depth	9m

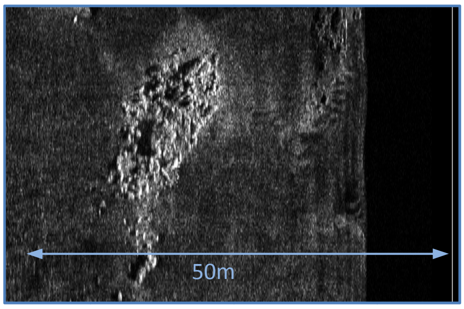


Small area of rocks on a soft silty sand seabed. A scattering of small iron pieces and iron concretions. Some of the iron is L-shaped in section.

Fig 74

Sidescan sonar image of target B825

Target	B825
Position	319195E 5552890N
Type	Iron
Estimated date	19-20th century?
Water depth	13m

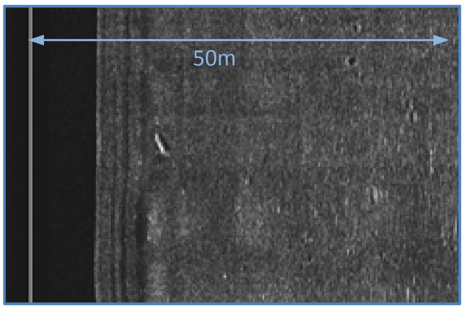


Several iron plates found 12m from anchor B825. The plates are approximately 0.85 x 0.55 x 0.02m and are probably from an iron wreck, possibly associated with the anchor B825. The plates are situated within an area of small rocks sat on coarse sand. This target requires further investigation.

Fig 75

Sidescan sonar image of target B359

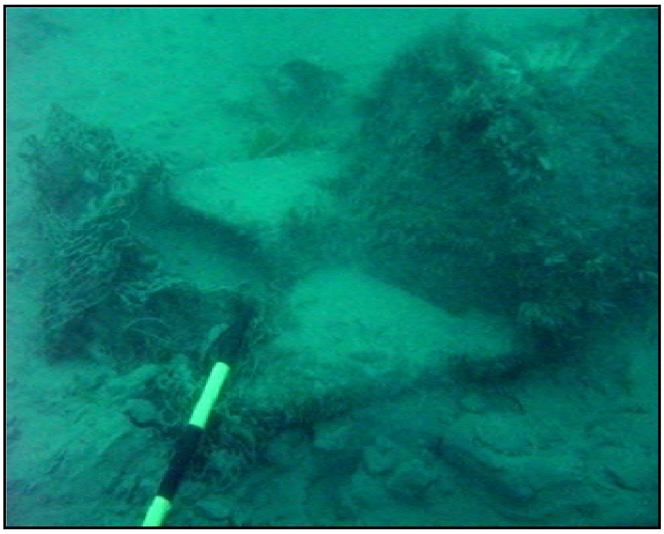
Target	B359
Position	320081E 5553562N
Type	Ordnance?
Estimated date	20th century
Water depth	15m



Bomb shaped object; case appears to be non-ferrous, possibly aluminium. One end has what appears to be fins. It is 3m long and cylindrical in cross-section (0.5m diameter). As this is possibly ordnance the item was only sketched and not surveyed. This could be a bomb, parachute mine or possibly a sonar beacon.

Fig 76

Underwater photograph showing the fins on the end of target B359. The scale has 0.10m divisions.



Conclusion

Most historic shipwrecks are discovered by accident or by searching for a particular documented wreck. The Mount's Bay survey was different in that we were searching a defined geographical area to see what maritime remains it contained. At the start of the survey the team naturally speculated on what would be found. Many hoped that a classical or early mediaeval vessel would be located; this was not to be. Archaeology, while appearing exciting and glamorous, is in reality often dull and laborious. This is particularly so when conducting large area geophysical surveys at sea. If it was easy someone would already have done it! All our surveys were non-intrusive - we only recorded what we could see on the seabed. It may be that the older material has disappeared into the sand and silts of the seabed.

Fig 77

Survey underway to the south of St Michael's Mount

One of the less tangible results of this survey was the skills the group has developed in this type of work. CISMAS members have now accumulated a great deal of knowledge of marine geophysical survey and underwater searching, this in a group comprising people from many different backgrounds, ages and vocations. The project was open to all members of the community.

Undoubtedly the most significant single discovery of the survey was the small nineteenth-century composite sailing vessel B022. It was remarkable that the wreck of this vessel lay undisturbed on the seabed less than 200m from one of the most popular dive sites in the Bay. The presence of the ship's bell and other finds on the seabed attest to the fact that this wreck was previously undiscovered. The name and date of loss of this vessel is not known. Research into losses in the area in the late nineteenth century has uncovered dozens of possible vessels, but none of these fit the remains exactly. It is also possible that the vessel was lost without survivors or witnesses, in which case the record of the loss of this vessel would not be linked with Mount's Bay. Further survey work on the wreck itself may throw more light on the matter. Sadly, since its discovery recreational divers have started to visit the wreck and remove material from the wreck, which may hamper any future identification.

The high resolution sidescan sonar images taken of well-known iron wrecks in the bay such as the Hellopes will prove useful in documenting their ongoing deterioration. Divers often relate how much a wreck has deteriorated since they started diving it – we now have an objective record against which to compare their future condition. The record of the Hellopes (fig 55) amply demonstrates how useful sidescan images can be in recording large iron wrecks.

CISMAS hope to continue searching the Mount's Bay area. We intend to start working from the area already covered towards the shore. This shallow water is more likely to contain wreck remains, but is a more challenging environment to conduct geophysics and survey in. We also have a great number of sidescan sonar targets which have not yet been investigated, and we intend to continue to search these targets. If any dive clubs would like a list of target positions to dive on, you can contact CISMAS at www.cismas.org.uk and we will provide you with a DVD containing sidescan targets, images and positions. All we ask in return is that you let us know what you find.

Kevin Camidge & Luke Randall
CISMAS
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The team

The following lists all those who took part in the CISMAS Mounts Bay Survey. All were volunteers and often used their valuable annual leave in order to take part.

Mark Albury	Phil Durban	Tony Pitchforth	Kerry McFarlane
Gail Alexander	Jeff Dicker	Hilary Paynter	Trish McCartney
Sharon Austin	Adrian Downing	Luke Randall	Alec Weyman
Tony Badham	Andrew Earle	Martin Reed	Carol Weyman
Peter Batchelor	Geoff Fuller	Phil Rees	Ian Whittaker
Ian Bonnick	Paul Herdman	Geoff Ralph	Simon Wheeler
Bill Bowen	Peter Holt	Brendon Rowe	Janet Witheridge
J Buchanon	Terry Horrocks	Malcolm Rowe	
Kevin Camidge	Chris Lobb	Richard Stoddern	
Sarah Chaddock	Graham McKay	Honor Thorley	
Keith Denby	John Macken	Innes McCartney	

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