Integrated assessment of the buried wreck site of the Dutch East Indiaman *'t Vliegent Hart*

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Introduction

In February 1735 the Dutch East Indiaman *'t Vliegent Hart* wrecked shortly after leaving Zeeland for Batavia (Indonesia). The three-master, roughly 44 m long and 11 m wide and armed with 42 guns, was built in 1729-1730 in Middelburg and served as a transport vessel between the Netherlands and Asia. For its second voyage to Batavia in 1735 it carried a cargo of wood, building bricks, iron, gunpowder and wine, as well as several chests with gold and silver ducats[4]. In the afternoon of February 3rd the vessel left the port of Rammekens near Vlissingen in convoy with a smaller ship, the *Anna Catharina*, and a pilot boat. A few hours after leaving the port in a northeasterly gale the *Anna Catharina* ran aground on one of the many sandbanks in the Deurlo channel (fig. 1) and perished. *'t Vliegent Hart* struck the same sandbank but managed to break loose with the rising tide. The damaged vessel, largely adrift, finally reached the deeper water of the Schooneveld (fig. 1) where it dropped anchor that night. Water poured into the broken hull and soon *'t Vliegent Hart* sank too, in 18 meters water depth[5]. In total, over 400 men were lost. Soon after the wreckage a chart was compiled by Abraham Anias, showing the location of the two wrecks[6] (fig. 2).

In the days following the wreckage, barrels filled with jenever (Dutch gin), beer and oil were washed ashore on the beaches of Blankenberge and Nieuwpoort[7]. Salvage operations undertaken by the pilot vessel shortly after the wreckage indicated that the wreck of *'t Vliegent Hart* was still largely intact and had sunk almost vertically onto the keel; the broken masts were still visible[8].

New salvage operations were undertaken in 1736 by the British diver Captain William Evans, using a wooden barrel with viewing and hand ports. Among the recovered artefacts were 700 wine bottles, one iron cannon, tablecloth, four silver ducats and one silver buckle[9]. The operations revealed that the wreck was by now largely destroyed, most likely a result of the severe winter storms of 1735-1736. The upper structure seemed to have disappeared largely and the ship was lying inclined on the seabed[10]. Because of the poor visibility and the difficult conditions no further salvage attempts were undertaken and gradually the wreck was forgotten.

In 1977 the wreck received renewed attention after the discovery of the manuscript chart compiled by Anias[11]. The Rijksmuseum of Amsterdam was contacted and a research team was put together. In 1979 and 1980 different search campaigns were undertaken by the mixed British-Dutch team[12] "North Sea Archaeological Group" (NSAG) led by Rex Cowan. But it was not until the end of 1981 that the wreck site was actually found (among 80 other wreck sites). Visible features such as dated coins, the sideplate of a musket and a VOC[13] cannon identified the wreck as *'t Vliegent Hart*[14]. The wreck was almost completely buried, and only small fragments were visible on the seabed. Between 1982 and 1984 a first series of salvage operations was carried out by divers of the NSAG. Recovered artefacts included a.o. wine bottles, bullets and a large number of lead ballast rolls. In July 1983 an intact coffer filled with 2000 gold ducats and a few thousand Spanish reals was found[15] (fig. 3).

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4 Van der Horst 1991.

5 Bruyns & van der Horst 2006.

6 *Ibidem.*

7 Van der Horst 1991.

8 Hildred (ed.) 2001.

9 Van der Horst 1991.

10 Van der Horst 1991.

11 Van der Horst 1991, 27.

12 At that time the border between the Belgian and Dutch part of the North Sea was not established yet and the wreck was supposed to be located in Dutch waters. Nowadays the wreck is located in Belgian waters.

13 Dutch East India company.

14 Bruyns & van der Horst 2006.

15 Van der Horst 1991.

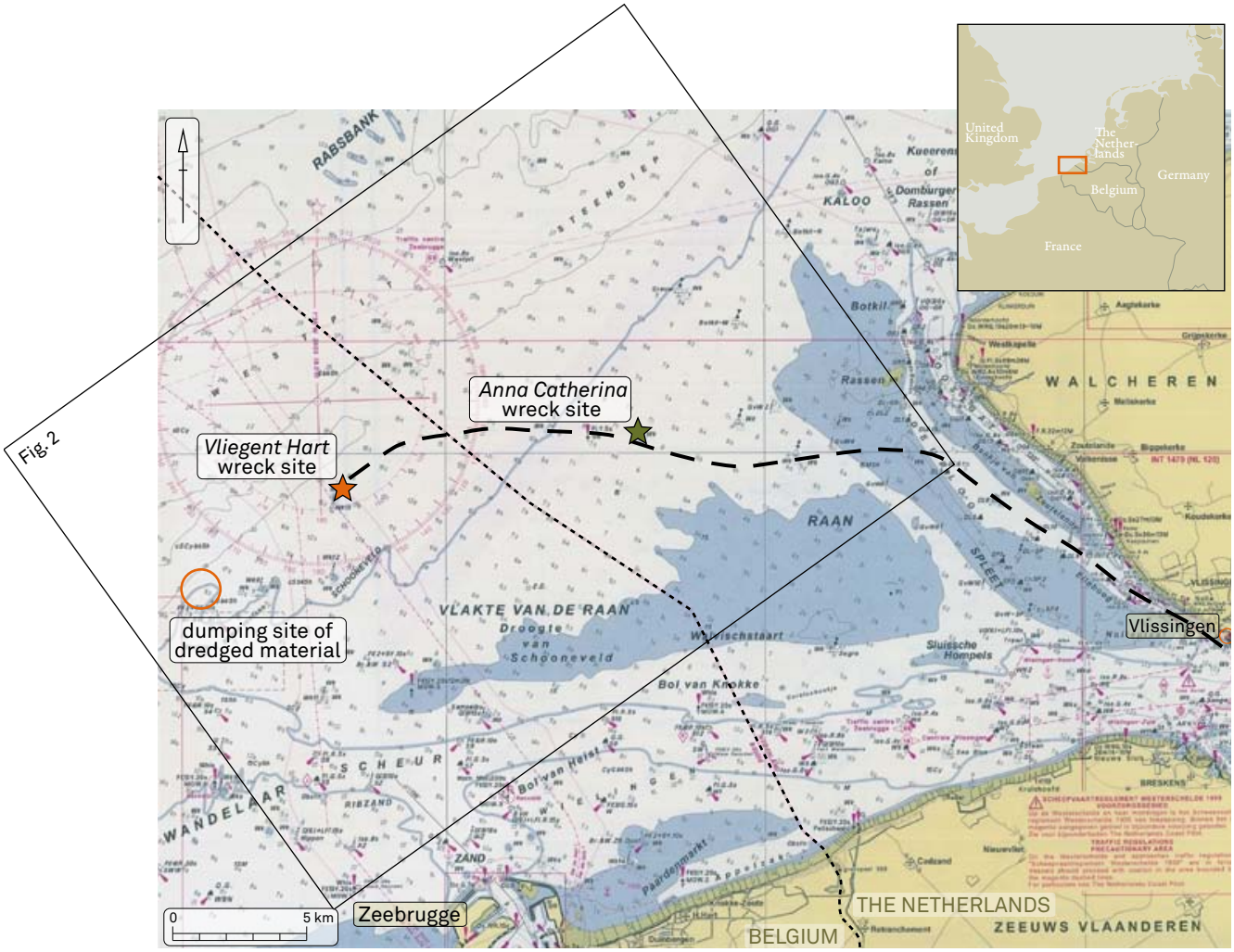

FIG. 1 **Nautical map of the Westerschelde estuary off Zeebrugge. The orange and green star respectively mark the wreck sites of *'t Vliegent Hart* and the *Anna Catherina*. The orange circle marks the dumping site of dredged material.**
Nautische kaart van de Westerscheldemonding ter hoogte van Zeebrugge. De oranje en groene ster markeren respectievelijk de wraklocatie van* 't Vliegent Hart *en de* Anna Catherina. *De oranje cirkel markeert de dumpplaats van baggerspecie.

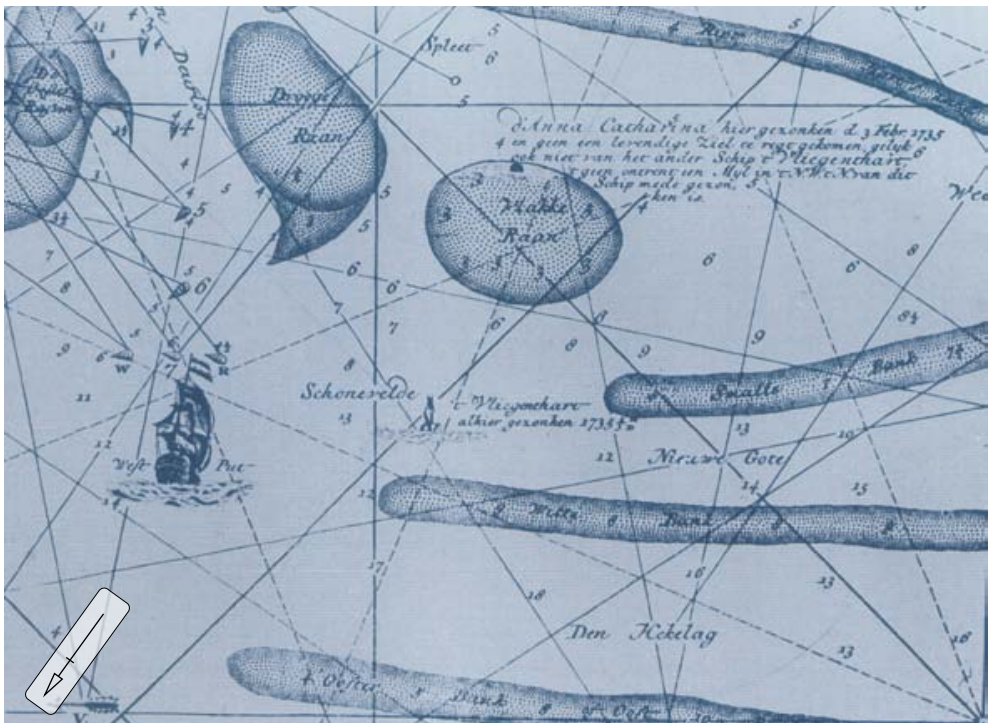

FIG. 2 **Fragment of a 18th-century chart marking the wreck sites of the Dutch East Indiamen *'t Vliegent Hart* and the *Anna Catherina*. The setting of the map is shown in fig. 1 (Johannes van Keulen in Hildred (ed.) 2001).**
Fragment van een 18de-eeuwse zeekaart met daarop de wraklocaties van de VOC-schepen* 't Vliegent Hart *en de* Anna Catherina. *De situering van deze kaart wordt weergegeven in fig. 1 (Johannes van Keulen in Hildred (ed.) 2001).

FIG. 3 **Gold ducats recovered from the Dutch East Indiaman *'t Vliegent Hart* (Pol 1993).**
***Gouden ducaten afkomstig van het VOC-schip* 't Vliegent Hart (Pol 1993).**

In July-August 1985 a new series of diving operations were carried out by NV Sills Consortium Salvage Ltd., also led by Rex Cowan, and under the archaeological supervision of Mark Hollingsworth. The operations were hindered by severe weather conditions and only a small area could be excavated. Different finds included a.o. iron cannons, bricks, wooden beams, concretions, and parts of the galley[16]. Two firebricks were presented to the Stedelijk Museum in Amsterdam. In 1988 and 1989 excavation works were again undertaken by the NSAG. The first operations were severely hindered by bad weather, but in 1989 good weather prevailed and a large number of finds were reported (including various artefacts from the officer's huts)[17]. Between 1991 and 1993 further diving expeditions and excavation works were undertaken by the same group. Recovered artefacts included a.o. bricks, lead containers, timber, cannons and cannon balls, wine bottles, and pipes[18]. In 1991 a second chest filled with gold ducats and Spanish reals was found, as well as several cases of silver ducats. The latter were not mentioned in the official cargo documents of the ship and most likely they formed part of illegal smuggling, a result of the favourable exchange rates in Asia[19].

A series of diving operations was carried out in 2000 in the framework of the VOC Anniversary Shipwreck Project (VOC ASP), with the support of the Oxford Maritime Trust. The responsible archaeologist was Alex Hildred, who also involved in the prestigious *Mary Rose* project in the UK. New finds included a.o. pottery, lead rolls, ceramics, bottles, coins, pipes and rigging fragments[20]. For a long period after that no official diving operations were carried out on the *'t Vliegent Hart* wreck site, and in 2007 the contract between Rex Cowan and the Dutch ministry of finance was officially terminated. The site however has been 'visited' regularly by wreck hunters and in 2008 and 2009 fishermen recovered two large cannons reported to be originating from the *'t Vliegent Hart* wreck site[21] (fig. 4). In 2010, the Flanders Heritage Agency started a new diving survey in order to map the current visible remains and compare them to the existing data of the wreck site. Various wooden structural elements as well as bricks and bottle fragments (often concreted together) were found.

1 National heritage and legal implications

The salvage contract of the *'t Vliegent Hart* wreck site must be situated in the larger context of the Dutch policy development. In 1798 the Dutch East India Company (VOC) went bankrupt and its possessions and debts were passed on to the Batavian Republic. The present Dutch State is still its juridical successor. If no other policy applies, the Dutch ministry of finances and her 'Dienst der Domeinen' act as manager of this state property[22].

16 Sills Consortium Recoveries Ltd 1985.
17 Van der Horst 1991.
18 3H Consulting Ltd 2005.
19 Van der Horst 1991.
20 Hildred (ed.) 2001.
21 *S.n.* 2008, *S.n.*2009a & *S.n.*2009b.
22 Information by Ir. M.A.J. Timmermans (former state secretary of finances, 2001), records Dutch National Cultural Heritage Agency.

FIG. 4 **Canon, recovered by a Dutch fishing vessel. It is likely to be originating from the wreck site of *'t Vliegent Hart* (Muzeeum, Vlissingen).**
Kanon, opgevist door een Nederlands vissersschip, vermoedelijk afkomstig van de wraksite van* 't Vliegent Hart *(Muzeeum, Vlissingen).

With the renewed attention of the *'t Vliegent Hart* wreck site in the late seventies, the Rijksmuseum of Amsterdam recommended Rex Cowan for salvaging the wreck site. Cowan, a former British lawyer, had been a business partner of the Dutch ministry of finances since 1968 and involved in salvaging several VOC-ships. In 1981 he received the rights on the *'t Vliegent Hart* wreck in return for handing over 25 percent of the profit. The salvage contract was concluded under the express condition that the wreck should be found before 1983. A concession area was established based on the 18th-century map, within 12 nautical miles off the coast. The project was financed by John Rose and the salvage operation was carried out by the "North Sea Archaeological Group" under supervision of the Rijksmuseum.

Early in 1983, shortly before the discovery of the first chest filled with gold and silver coins, a new distribution code came into force whereby only 10% of the profits should be handed over to the Dutch state. This gave rise to a heated debate in the Netherlands regarding the ethics of wreck salvaging[23]. In addition, the salvage teams were severely criticized for their lack of reporting (even the exact wreck location was never revealed) and the poor archaeological research. This resulted in the withdrawal of the Rijksmuseum from the project in 1984. Henceforth the archaeological supervision appeared to have become subordinate to the salvage operation, which strengthened the impression of a commercially driven operation instead of careful scientific investigation of valuable cultural heritage.

Even though the salvage approach towards the recovery of archaeological finds sometimes seemed to clash with the regulations of the Dutch Monument Act[24], the contract with the Dutch ministry of finances was to be respected as the concession zone was at that time still lying in international waters. But the expansion of the territorial waters from 3 to 12 nautical miles in 1985 caused some confusion. According to the Dutch Monument Act a contract for salvaging cultural heritage within territorial waters cannot be closed by the Dutch ministry of finances without consulting the ministry of culture, manager of the Dutch cultural heritage. With the extension of the territorial water boundary, however, the concession zone for the wreck salvage was lying just inside the 12 nautical miles zone but in a disputed area between Belgium and the Netherlands. In 1996 a border treaty between Belgium and the Netherlands established the borders of the territorial waters and continental shelf of the two nations. The concession zone was now lying partly within Belgian territorial waters.

For most of the duration of the salvage and excavation works, the exact position of the wreck itself was never officially reported. But as it finally turned out, the actual *'t Vliegent Hart* wreck site was lying slightly outside the concession zone and is located fully within Belgian territorial waters. The Dutch ministry of finances is allowed to conclude salvaging contracts of VOC wreck sites in foreign territorial waters, taking into account the national legislation of this country[25], in this case Belgium.

Belgium for its part has a complex state structure and this also shows in the protection of the archaeological heritage. Whereas immovable heritage falls under the authority of the Regions (Flanders, Wallonia and Brussels), the North Sea belongs to the

23 Maarleveld 2006.
24 http://wetten.overheid.nl/BWBR0021162/geldigheidsdatum_29-10-2010.
25 Information by Mr. Eeuwke Faber (former Legal advisor Dutch ministry of foreign affairs, 2000), records Dutch National Cultural Heritage Agency.

Belgian Federal level. In order to allow a better management of the underwater heritage within the Belgian part of the North Sea, in 2004 these two parties concluded a cooperation agreement, until now however limited to a declaration of intent[26]. The agreement stipulated a.o. the realization of a database of maritime heritage in the North Sea, under the responsibility of the Flanders Heritage Agency in cooperation with the province of West-Flanders. The database is accessible to the public and policy makers and new information is added continuously through archival and in-situ research[27].

Two further steps were taken in recent years. In 2007 a new so-called Wreck Act was adopted by the federal parliament, replacing the (still existing!) 16th-century Wreck Edict. This new Wreck Act regulates the ownership of wrecks and wreck parts within Belgian territorial waters and creates a juridical base for the protection of archaeological and historical valuable wrecks[28]. However, this new legislation still lacks the royal decrees and has not entered into force yet. In July 2010 the Flemish Government also ratified the Unesco Convention on the protection of Underwater Cultural Heritage[29]. As it concerns a mixed treaty, it will only come into force after additional approval of the other Belgian Regions and ratification by the federal government. Notwithstanding all efforts, these different steps so far have no legal implication which currently makes it difficult to enforce any regulation.

2 Geological and hydrological setting of the wreck site

The *'t Vliegent Hart* wreck site is located roughly 18 km offshore Zeebrugge, north of the so-called Vlakte van de Raan (fig. 1). The Quaternary deposits mainly consist of Holocene sediments with a thickness of no more than 6-7 m. A detailed study of the recent deposits of the Belgian Continental Shelf has indicated three main Holocene units in the area[30]. The uppermost unit (roughly 0.5 to 2 m thick) consists of fine sandy sediments with clay and silt layers and locally high shell content. Its base is often characterized by a shell or gravel lag. The thin middle unit (0 to 1 m thick) is made up of fine sand with few shell fragments. The lower unit (3 to 5 m thick) mainly contains fine to medium-fine sand with shell fragments and numerous silt and clay admixtures, and locally peat fragments. However we should keep in mind that the Quaternary sediments of the Belgian continental shelf are very heterogeneous, and marked by a high lateral and vertical variability[31]. It is therefore possible that the local geology at the wreck site may differ somewhat from the description given above.

The proximity of a large dumping site of dredged material located roughly 8 km southwest of the wreck area (orange circle on fig. 1) has influenced the most recent deposits. The dumping ground came into use in 1966; its position was shifted slightly (1-2 km) to the NW in 1984 and in 1999[32]. The dumped material consists of fine silty material with a high mud content, most likely due to the frequent location of dredging areas in high turbidity zones[33]. Since the residual transport in this area is roughly oriented SW-NE, the soft sediments from the dumping site are transported towards the wreck site[34]. This has resulted in the deposition of a mobile layer of soft muddy or silty sediments with varying thickness.

The water depth at the wreck site today is roughly 14 m below MLLWL (mean lowest low water level at spring tide). Tidal currents in the area have velocities ranging from 0.6 to 1 m/s[35]. The main current directions are SW-NE (flood) and NE-SW (ebb), with maximum values reached during flood. It is expected that these tidal currents may induce (or have induced) scour processes at the wreck site. The scouring will not only depend on the wreck itself (orientation, morphology, size) but also on the tidal regime and the seabed[36]. Often the sub-surface geology will act as a control on the scouring depth. The scour also affects the site disintegration, as exposed wreck parts are subject to increased corrosion rates whilst buried wreck components tend to corrode more slowly[37].

3 Previous diving investigations and excavation works (1981-2000)

Various diving surveys have been carried out on the wreck site between 1981 and 2000. However in most cases no diving reports were published. Therefore a short overview of the different diving investigations and excavations is presented here.

3.1 Diving investigations in 1981-1985

When the wreck was discovered in 1981, the only visible parts consisted of small remains on the seabed oriented along a NW-SE axis, including a.o. wooden beams, cannons, fishing nets and trawls[38]. Subsequent diving investigations showed that the appearance of the wreck site was able to change rapidly over time; for instance some wreck parts that were still clearly visible in 1982 were missing in 1983. This was most likely due to the combined effect of recent sedimentation (possibly enhanced by the nearby dumping ground) and the fishing nets causing severe damage to the site. Fishing activity was confirmed by side-scan sonar data which showed clear trawl marks, and the large quantities of rope and fishing gear found at the wreck site[39].

Structural fragments found in 1983 included remains of the stern and hull on the port side (fig. 5). They can most likely be linked to the lower hold of the ship. The fragments indicate that the stern lays inclined to the port side at an angle of 55 degrees[40]. Further to the southeast three cannons, various lead rolls and fishing nets were found (fig. 5). The western side of the wreck site showed an abrupt slope, while towards the east the slope was more gentle[41].

26 De Weirdt 2006.
27 www.maritieme-archeologie.be.
28 Wreck act 2007: art. 16–17 (Moniteur Belge–Belgisch Staatsblad 21/06/2007).
29 *Decreet van 16 juli 2010 houdende instemming met het verdrag ter bescherming van het cultureel erfgoed onder water, aangenomen in Parijs op 2 november 2001*, Moniteur Belge - Belgisch Staatsblad 09/08/2010.
30 Mathys 2009.
31 Le Bot *et al.* 2005.
32 Du Four 2004.
33 *Ibidem.*
34 Lanckneus *et al.* 2002.
35 *Ibidem.*
36 Quinn 2006.
37 *Ibidem.*
38 Van der Horst 1991.
39 Gawronski & Kist 1984.
40 *Ibidem.*
41 *Ibidem.*

An area of roughly 3x6 m was excavated down to 1 m depth (fig. 5); no dispersed material was observed north of this area. Similar to 1981 the shallow sediments consisted of a thin surface layer of sandy silt overlaying sandy-clayey deposits marked by a hard shell layer at the bottom. Most likely this layer can be linked to the upper Holocene unit described by Mathys[42]. Most of the artefacts were found in the underlying clay layer (<0.5 m thick), which seems to suggest that the ship sunk to this layer at the time of the wreckage[43].

In 1984 the surveyed area was slightly enlarged which resulted in more wreck fragments, including part of a lead sluice pipe[44]. Diving operations carried out in 1985 showed that the 1983 excavation pits had been completely filled up with silt and mud[45]. The remains of the hull, which were exposed some 25 cm above the seabed in 1983 (stake and ribs (A) on fig. 5), were now completely covered by sediment. Again this indicates a fast changing sedimentation pattern. In 1985 a large trench of 6x6 m was excavated east of the hull structure (fig. 5). The results showed that the hull remains extend down to no more than 2 m[46]. The local presence of a hard shell-rich layer at 30-50 cm below the seabedfloor (bsf) made hand digging very difficult. The most important finds in 1985 involved fragments of the galley[47].

3.2 Diving investigations in 1988-1993

In 1988 the survey area was extended in southeasterly direction towards the bow. The results showed that the port side of the stern was preserved over a distance of 12 m[48]. No remains of the starboard side of the stern were found. In 1989 a 6x6 m trench was excavated north of the sternpost (fig. 6). Remains of the rudder suspension were detected, but the rudder itself was not found. A lot of wreck material was found in the excavated area, mostly from the officer's huts. The depth of the structural remains and artefacts varied roughly between 0.5 and 2 m bsf[49].

During the subsequent diving operations in 1991-1993 again a large area east of the sternpost was excavated. A schematic drawing was made of the wreck site, based on historical drawings and the results of recent diving operations (fig. 6)[50]. Artefacts were found mainly on the port side. This is most likely due to the inclination of the ship which resulted in objects falling outboard off the port side. The nature of the artefacts confirms that the exposed stern section is located in the lower part of the ship. The superstructure of the stern seems to have disappeared completely, at least in the stern section and down towards the middle of the ship.

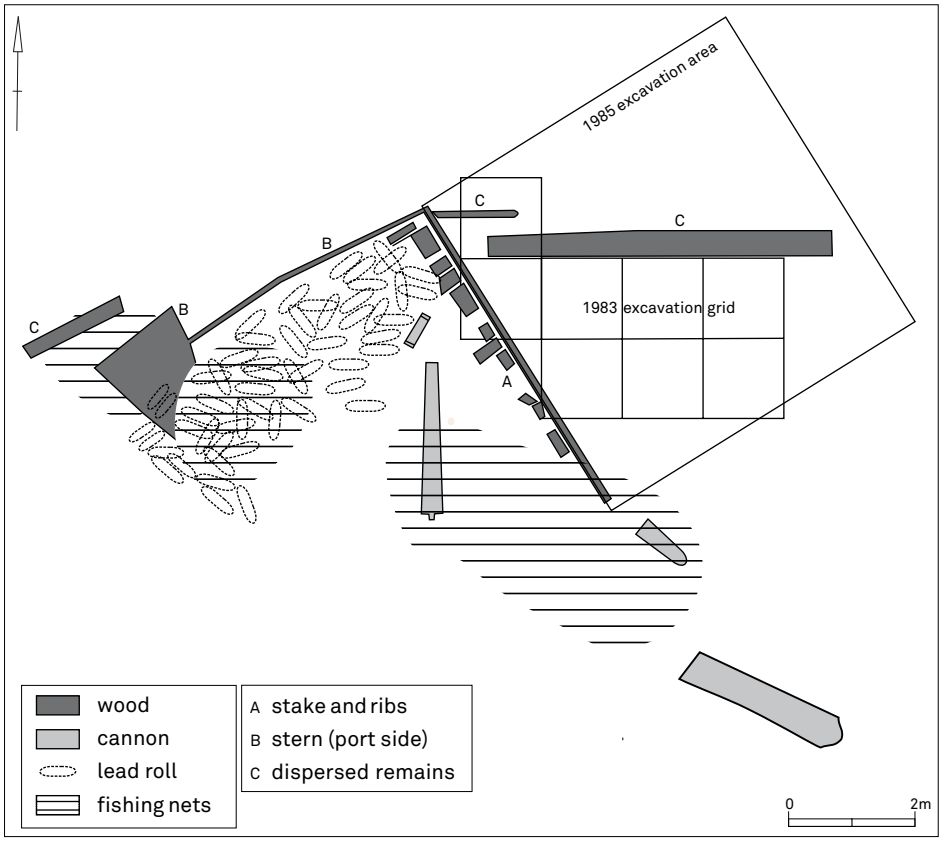

FIG. 5 Remains of *'t Vliegent Hart* wreck site observed during diving investigations in 1983 (after Gawronski & Kist 1984). Structural fragments include a.o. wooden fragments of the stern (B) and hull (A). Nearby also several cannons and a large number of lead rolls were found, partly covered by fishing nets. The 1985 excavation area is also shown on the right (after Sills Consortium Recoveries Ltd 1985). ***Overblijfselen van het wrak van* 't Vliegent Hart *zoals blootgelegd tijdens het duikonderzoek in 1983 (naar Gawronski & Kist 1984). Houten fragmenten van de opbouw zijn o.a. afkomstig van de achtersteven (B) en de scheepsromp (A). Vlakbij werden ook een paar kanonnen en een groot aantal loden ballastrollen gevonden, gedeeltelijk bedekt door vissersnetten. Het opgravingsgebied uit 1985 is ook aangeduid rechts (naar Sills Consortium Recoveries Ltd 1985).***

42 Mathys 2009.
43 Van der Horst 1991.
44 *Ibidem.*
45 Sills Consortium Recoveries Ltd 1985.
46 Sills Consortium Recoveries Ltd 1985.
47 Van der Horst 1991.
48 *Ibidem.*
49 *Ibidem.*
50 3H Consulting Ltd 2005.

3.3 Diving investigations in 2000

In 2000 three extra trenches were excavated near the sternpost and on the port side of the wreck (see fig. 6)[51]. The excavated areas were located both inside and outside of the wreck structure. The results confirm that the main stern remains are located between the sternpost and the port side. There seems to be no indication of a collapse of the port side to the east. The inclined sternpost protruded roughly 0.5 m above the surrounding seabed. Fishing nets, chains and ropes were found tangled around the sternpost. The structural remains of the hull confirmed the large gap roughly 12 m south of the stern[52].

The sediments in trench 1, near the sternpost, consisted of a thin layer of sandy silt with shell fragments overlying a thick sandy clay layer with wreck debris. Towards the northwest the deposits became more sandy. At roughly 1.5 m below the sea floor (bsf) several long poles were found, overlying wreck debris which seemed to be consolidated into one big amorphous mass[53]. Exploration of trench 2 revealed numerous bricks covered by a thin layer of silt. The bricks were stored lengthways in parallel layers. The increasingly random stacking pattern towards the port side suggests that the bricks slipped towards the port side due to the inclination of the vessel. Various objects were found in trench 3, most likely these had fallen from the decks above outside the port side of the ship. Artefacts in trench 3 were rarely found below 1.2 m bsf. The sediments in trench 3 consisted of sandy deposits marked by thin layers of organic material and clay[54].

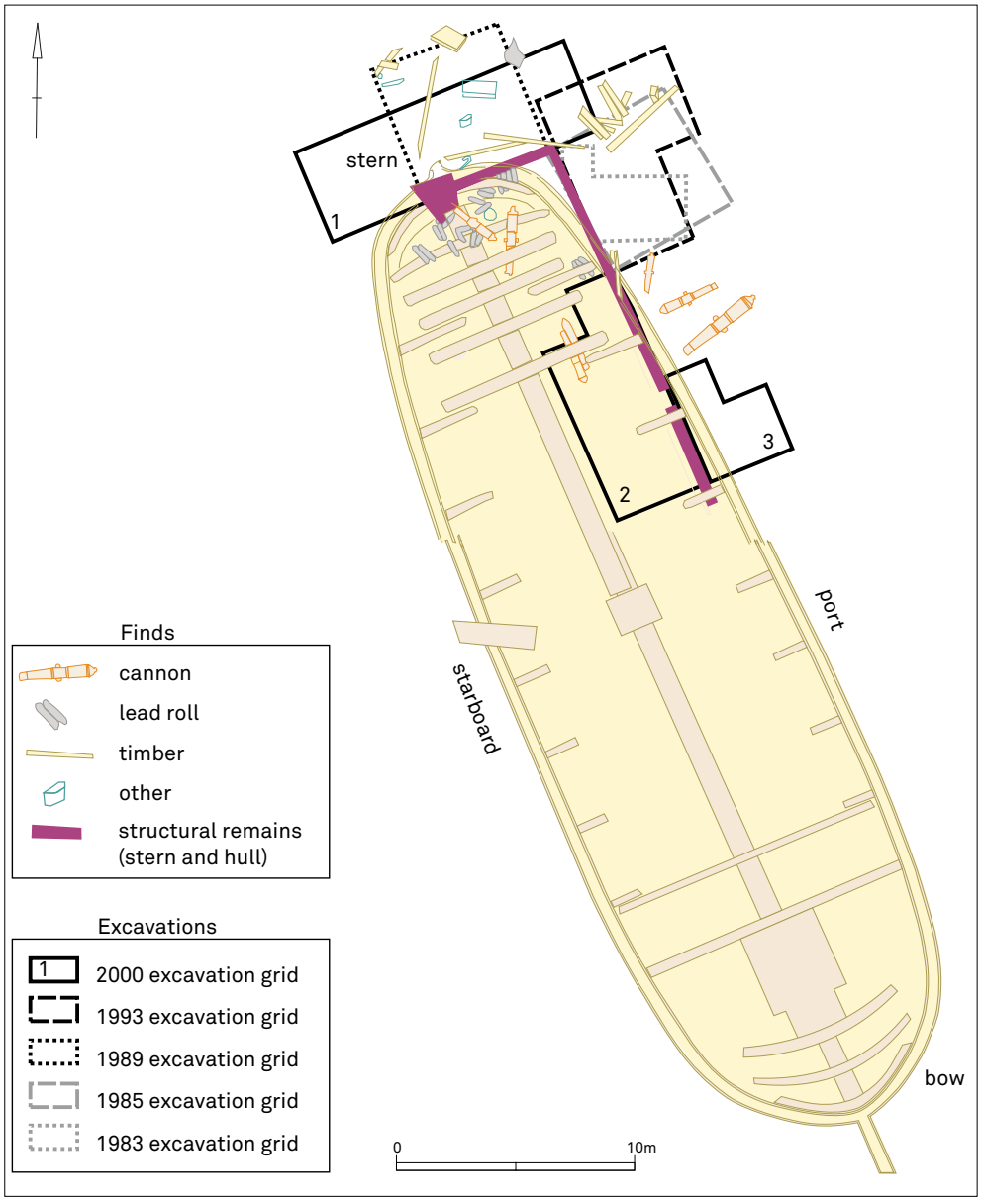

FIG. 6 Schematic drawing of the wreck based on historical drawings and excavation works in 1988-1993 (after 3H Consulting Ltd 2005). Different finds are indicated. Black and grey rectangles mark the trenches excavated in 1983, 1985, 1989, 1993 and 2000 (trench 1, 2 and 3). The structural remains of the stern and hull are marked in purple.
Schets van het wrak gebaseerd op historische tekeningen en opgravingswerken uit 1988-1993 (naar 3H Consulting Ltd 2005). Verschillende vondsten uit 1988-1993 zijn aangeduid. De grijze en zwarte vierhoeken markeren de verschillende opgravingsgebieden uit 1983, 1985, 1989, 1993 en 2000 (sleuf 1, 2 en 3). Fragmenten van de achtersteven en de scheepsromp (spantconstructie) zijn in het paars aangeduid.

51 **Hildred (ed.) 2001.**
52 ***Ibidem.***
53 ***Ibidem.***
54 ***Ibidem.***

4 Recent imaging and diving investigations (2009-2010)

4.1 Multibeam and side-scan surveys

In 2007 a first attempt was made to visualise the current state of the wreck site. Multibeam soundings were carried out by the Flemish Hydrographic Service (MDK-Afdeling Kust-Vlaamse Hydrografie) over the (hitherto) known wreck position, but no traces were found of the VOC wreck. In March 2009 side-scan sonar images were obtained by the Renard Centre of Marine Geology (RCMG, Ghent University) which allowed to pin-point the correct position of the wreck. Shortly afterwards (April 2009) multibeam soundings were carried out by the Flemish Hydrographic Service which resulted in a clear image of the wreck. The side-scan and multibeam images are shown in figs. 7 and 8. For a better comparison the outline of the wreck, based on the schematic drawing from 1993, has been added in the background.

Both side-scan and multibeam data clearly show that the wreck (or what is left of it) is almost completely buried, with only small fragments exposed on the seabed. The largest visible feature is related to the stern. Although it protrudes only a few decimeters above the average sea floor, it is surrounded by a small depression (yellow-orange area on the multibeam images) which enlarges the contrast. A number of sea-floor features stand out clearly on the side-scan image but are much less pronounced, in some cases not visible, on the multibeam image. Elongated features are possibly related to wooden beams, or perhaps cannons. This was later confirmed by the diving investigations in 2010 (see section 4.2). Most of the observed features are located on the starboard side. This could be due to the tilted position of the wreck, with the starboard side higher than the port side.

The multibeam images indicate that the wreck site is surrounded by a large shallow depression (roughly 0.6 m deep). The seafloor surrounding this depression gently dips towards the northwest. It is not unlikely that this depression is partly a residue of scouring that took place when the wreck structure was still largely exposed on the seabed. Neither side-scan nor multibeam data show clear traces on the seabed of the different excavation surveys performed in the 80's and 90's, which is not surprising given the long time span (over 8 years) and the highly dynamic sedimentary regime.

4.2 Diving investigations in 2010

In the framework of the project 'Archaeological Atlas of the 2 Seas'[55] (Interreg IVA programme) a number of diving surveys were carried out at the wreck site in summer 2010 (June, August and September) in order to get more insight into the visible wreck remains and to start a detailed registration of the site. The diving surveys were carried out by the Flanders Heritage Agency (Agentschap Onroerend Erfgoed) in collaboration with HWTMA (UK) and Adramar (F). Due to the limited visibility on the site visual material such as photographs and videos remain scarce, but nonetheless the 2010 diving survey has been successful in terms of observations and first registration.

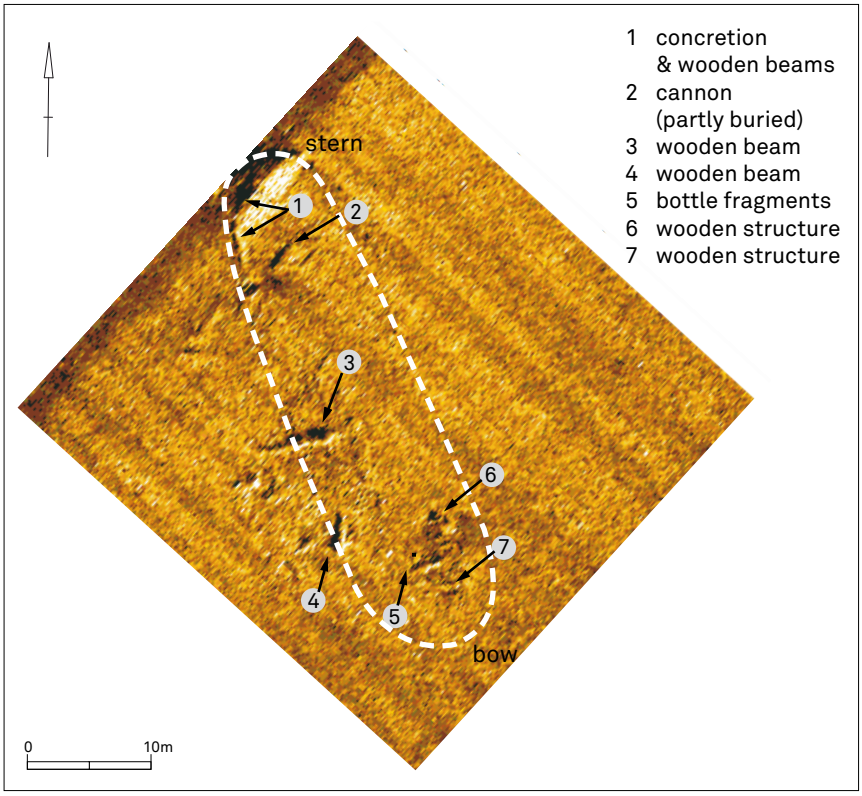

FIG. 7 Side-scan sonar image obtained in 2009 from the *'t Vliegent Hart* wreck site (courtesy by RCMG). The dotted line marks the (supposed) outline of the ship based on 1993 data (see fig. 6). The stern remains stand out clearly at the top. Different smaller fragments protruding from the seabed are observed near the bow. Elongated features are most likely due to wooden beams or cannons. Numbered arrows refer to some of the wreck remnants observed in 2010 (see fig. 9).
Side-scan sonar opname uit 2009 van het wrak van* 't Vliegent Hart *(RCMG). De stippellijn markeert de (vermeende) contouren van het schip gebaseerd op gegevens uit 1993 (zie fig. 6). De uitstekende achtersteven is duidelijk zichtbaar. Verspreide kleinere wrakfragmenten zijn te zien naar de boeg toe. Langwerpige objecten zijn waarschijnlijk toe te wijzen aan houten balken of kanonnen. De cijfers verwijzen naar een aantal wrakfragmenten waargenomen in 2010 (zie fig. 9).

55 www.atlas2seas.eu.

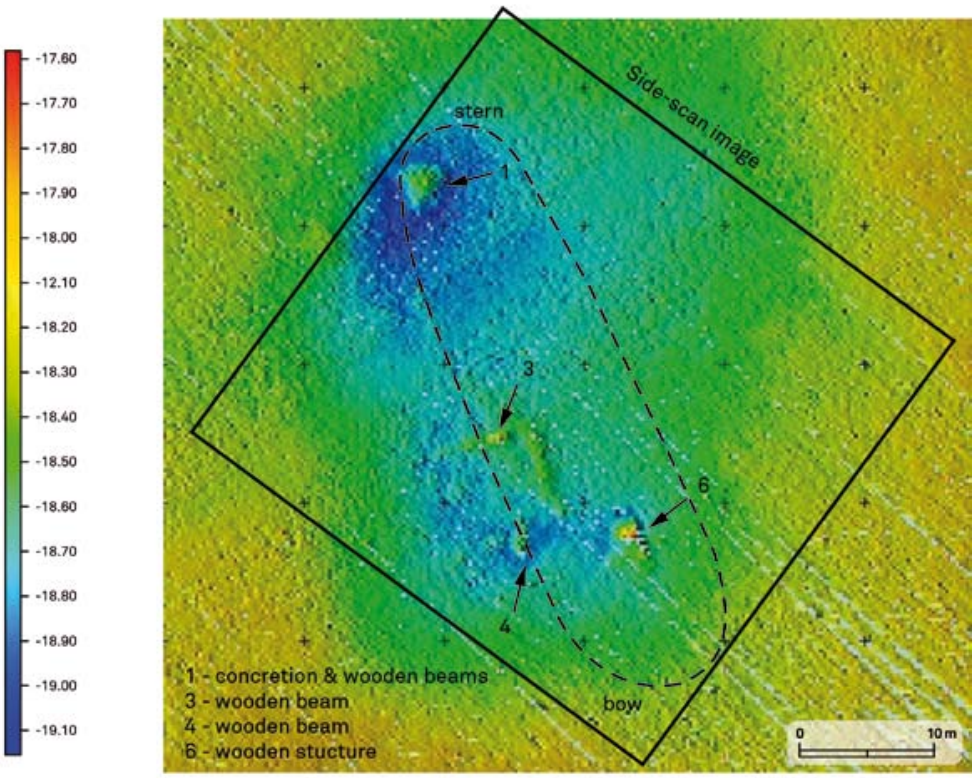

FIG. 8 **Multibeam image obtained in 2009 from the *'t Vliegent Hart* wreck site (courtesy by MDK - Afdeling Kust - Vlaamse Hydrografie). Depth in m MLLWS (Mean Lowest Low Water level at Spring tide). The dotted line marks the (supposed) outline of the ship based on 1993 data (see fig. 6). Only few protruding wreck fragments are observed. Elongated features are most likely due to wooden beams or cannons. The stern remains stand out clearly. Numbered arrows refer to some of the wreck remnants observed in 2010 (see also fig. 9).**

Multibeamopname uit 2009 van het wrak van* 't Vliegent Hart *(MDK - Afdeling Kust - Vlaamse Hydrografie). Diepte in m GLLWS (Gemiddeld Laagste Laag Water bij Springtij). De stippellijn markeert de (vermeende) contouren van het schip gebaseerd op gegevens uit 1993 (zie ook fig. 6). Slechts enkele uitstekende wrakfragmenten zijn zichtbaar. Langwerpige objecten zijn waarschijnlijk toe te wijzen aan houten balken of kanonnen. De uitstekende achtersteven is duidelijk zichtbaar. De cijfers verwijzen naar een aantal wrakfragmenten waargenomen in 2010 (zie fig. 9).

The results indicate the presence of a number of scattered wreck remains on the seabed over a length of 37 m. A schematic overview of the exposed wreck remains observed in 2010 is presented in figure 9. In the northwest a partly buried cannon was observed adjacent to a large elevation (also clearly visible on side-scan and multibeam data) with metal concretions but also wood, rope (presumably remains of old fishing nets) and sediment. This concretion is bound on the northwest side by two sloping wooden timbers. Most likely the timber could be related to part of the stern. These results are consistent with previous diving observations (1983, 2000) revealing wood constructions, fishing nets, ropes and concretions in this area as well as several cannons[56]. However this time no structural remains of the sternpost and adjoining hull were observed on the port side. This is not so surprising since these remains were chiefly found below the seabed after careful excavation.

More importantly, the 2010 diving investigations also revealed structural remains of timber and large beams in the southeast, towards the bow. The most northern feature in that area is part of a large wooden beam, concreted together with smaller wooden fragments and with an elevation of up to 0.5 m above the sea floor. It matches well with the sharp protruding feature (nr. 6) observed on the multibeam images (fig. 8) and the side-scan data (fig. 7). This feature could not yet be identified. Its size might however suggest it is part of a crossbeam of the ship. The most southern wooden structure consists of two long wooden beams following the length of the interpreted wreck orientation. In between is a series of wooden planking, superimposing the western beam and underlying the eastern beam and lined up very close to one another. The latter seems to suggest that we are dealing with hull or ceiling planking, nearing the end of the hull structure, either near the keel or the bow of the ship. The other two beams might be part of floor timbers.

56 Gawronski & Kist 1984; Hildred (ed.) 2001.

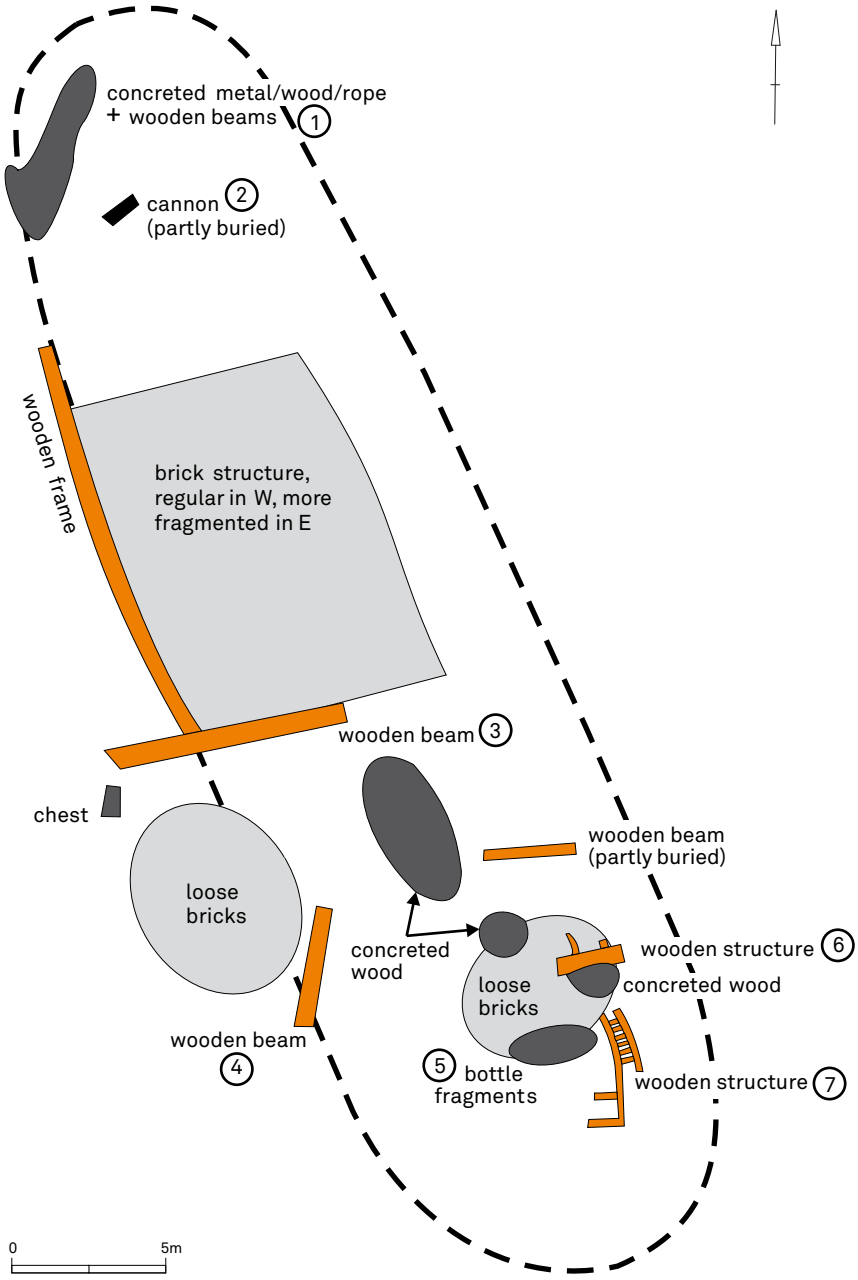

FIG. 9 Schematic drawing of the wreck and structural remains exposed during diving investigations in 2010. The dotted line marks the (supposed) outline of the ship based on 1993 data (see fig. 6). Numbers refer to marked features observed on the 2009 side-scan and multibeam data (see figs. 7-8).
Schets van de wrakfragmenten waargenomen op de zeebodem tijdens de duikcampagnes van 2010. De stippellijn markeert de (vermeende) contouren van het schip gebaseerd op gegevens uit 1993 (zie fig. 6). De cijfers verwijzen naar verscheidene elementen waargenomen op de side-scan- en multibeambeelden uit 2009 (zie fig. 7-8).

It is the first time that (presumed) remnants of the bow part of the wreck were recorded and the data seem to confirm that only the lower part of the wreck has survived. Besides the wood structures also a lot of scattered artefacts such as loose bricks, lead shots, broken and intact onion shaped bottles (the latter mostly concreted together in small clusters) were observed in the southeast.

Further to the north, an elongated structure of over 10 m long with regularly aligned bricks was observed. Although the exact position of this structure is still liable to some uncertainty (due to the limited survey and insufficient georeference), it can most likely be linked to the brick layers observed in 2000 (see section 3.3). The assembly of loose bricks is regularly aligned in the length of the wreck (resembling a turned over wall) and is likely the ship's ballast, probably combined with a function as cargo of building material. The western edge of the brick area is bounded by wooden timbers sticking out of the sediment which seem to indicate remaining parts of the hull structure (hull planking - floor timbers or futtock and ceiling planking) on starboard side where the bricks were stacked. Towards the east the brick structure becomes increasingly irregular. South of the main brick area, on the starboard side, a concreted regular (tool?) box and a long and broad wood concreted beam (possibly one of the riders of the ship) were observed. The latter corresponds well with the elongated feature clearly visible on the multibeam and side-scan data (figs. 7 and 8, feature nr. 3).

Many of the wreck remains observed on the seabed in 2010 correspond well with prominent features on the side-scan and multibeam data from 2009 (see numbered arrows in figs. 7 and 8), but in some cases no match was found. The diving surveys in August and September 2010 also revealed larger parts of timber than in June. This further confirms the fact that the site is sub-

ject to variable (and fast changing) sedimentation, and helps to explain the difference in observations between the recent diving observations and the results from previous diving campaigns. The 2010 diving observations still revealed the presence of fishing with trawl nets which indicates that the site is possibly also degraded by fishing activities. Further detailed recording of the wreck site by divers will be carried out by the Flanders Heritage Agency in the coming years.

5 Seismic imaging

In order to get a better understanding of the buried remains of the wreck and its actual condition seismic measurements were carried out by RCMG (Ghent University). In marine seismic imaging an acoustic source and receivers are towed behind a ship. The source emits an acoustic pulse that travels through the water and is reflected from the seabed and subsequent layers of the subsoil. The reflected signal then travels back through the water to the receiver. The received signals are recorded, and as the ship constantly moves this will result in a vertical cross section through the seabed. So-called reflectors on the seismic image mark the boundary between two distinct subsurface layers. In our case the acoustic signals will also be reflected by the various wreck fragments, both buried and exposed.

The sound source during the seismic survey consisted of a parametric echosounder. This source emits two signals with a different frequency[57]. The high-frequency signal (100 kHz) allows a very detailed image of the sea floor. Generally it does not penetrate more than a few cm into the sea floor. The secondary signal has a lower frequency (between 6 and 14 kHz) and therefore is able to penetrate much deeper (up to a few tens of meters, depending on the sediment), resulting in an image of the underlying structure. Since our main goal is to look for buried wreck remains we will focus here on the low-frequency data. The fast pulse rate (20-25 pulses per second) results in a high lateral coverage. During the measurements the echosounder was attached on a long iron pole fastened to the side of the ship. A motion sensor was used to filter out the wave movement. Positioning was done using a DGPS antenna with an accuracy of ±1 m.

A first reconnaissance survey was carried out in May 2009 on board the vessel *Big Game*. Wind and waves, in combination with strong tidal currents, made navigation very difficult and severely reduced the data quality. In addition the highly variable vessel speed, ranging from 3 to 6 knots, further complicated the data. A second seismic survey was therefore carried out in April 2010 on board the vessel *Last Freedom*. This time the weather conditions were more favourable and a grid of 49 profiles was recorded

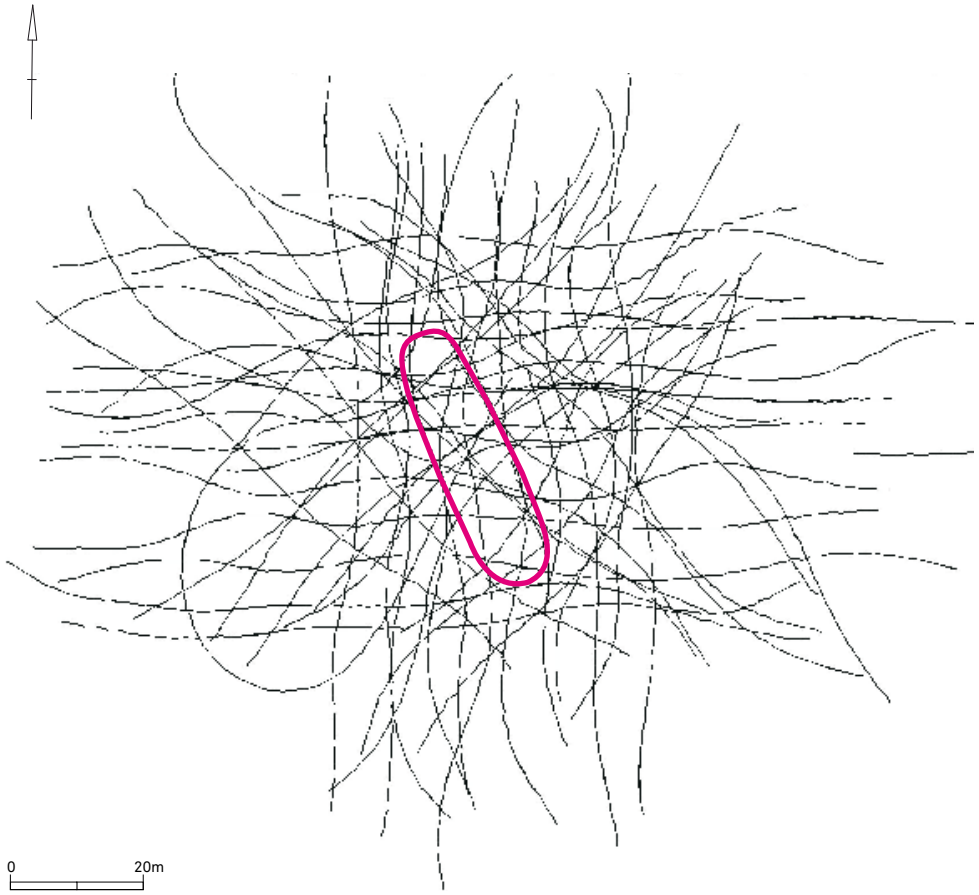

FIG. 10 **Seismic network recorded over the wreck site of *'t Vliegent Hart* in 2010. The red ellipse marks the (supposed) location of the wreck. In total 49 profiles were recorded crossing the wreck at different angles.** ***Seismisch netwerk opgenomen over het wrak van* 't Vliegent Hart *in 2010. De rode ellips markeert de (vermeende) locatie van het wrak. In totaal werden 49 profielen opgenomen die het wrak kruisen onder verschillende hoeken.***

57 **Wunderlich *et al.* 2005.**

over the wreck site (fig. 10). Vessel speed was kept at roughly 3,5 knots, which resulted in high and regular seafloor coverage. The seismic data that are discussed in the following paragraphs were all obtained during this second survey.

The low-frequency seismic data are often marked by limited penetration of a few meters. This may be due to a (relatively hard) sandy-silty seabed, or to the presence of (small amounts of) biogenic gas in the shallow sediments. In this case we believe it to be a combination of both. Nevertheless some interesting observations were made. A first remarkable observation is the lack of a continuous high-amplitude subbottom reflector which often marks the outline of a buried wooden wreck structure[58]. This seems to support the theory that the wreck fragments are few and scattered. However it is not unlikely that the state of the wooden artefacts may also have played a role here. Indeed it is known that seismic detection of wood that is heavily degraded can sometimes become difficult[59].

In the following paragraphs different aspects of the seismic data are discussed. Figures 11 and 12 show examples of seismic profiles crossing the wreck at different angles. All depths are in m TAW. The location of each profile is shown on the right plotted against a side-scan background map and the (supposed) wreck contour. Circles mark various exposed/buried objects and wreck remains. Numbers refer to wreck remnants observed during the diving surveys of 2010 (fig. 9). Figure 13 shows a composite interpretation map, indicating the different buried wreck remains and scour/infill areas as interpreted from the seismic data.

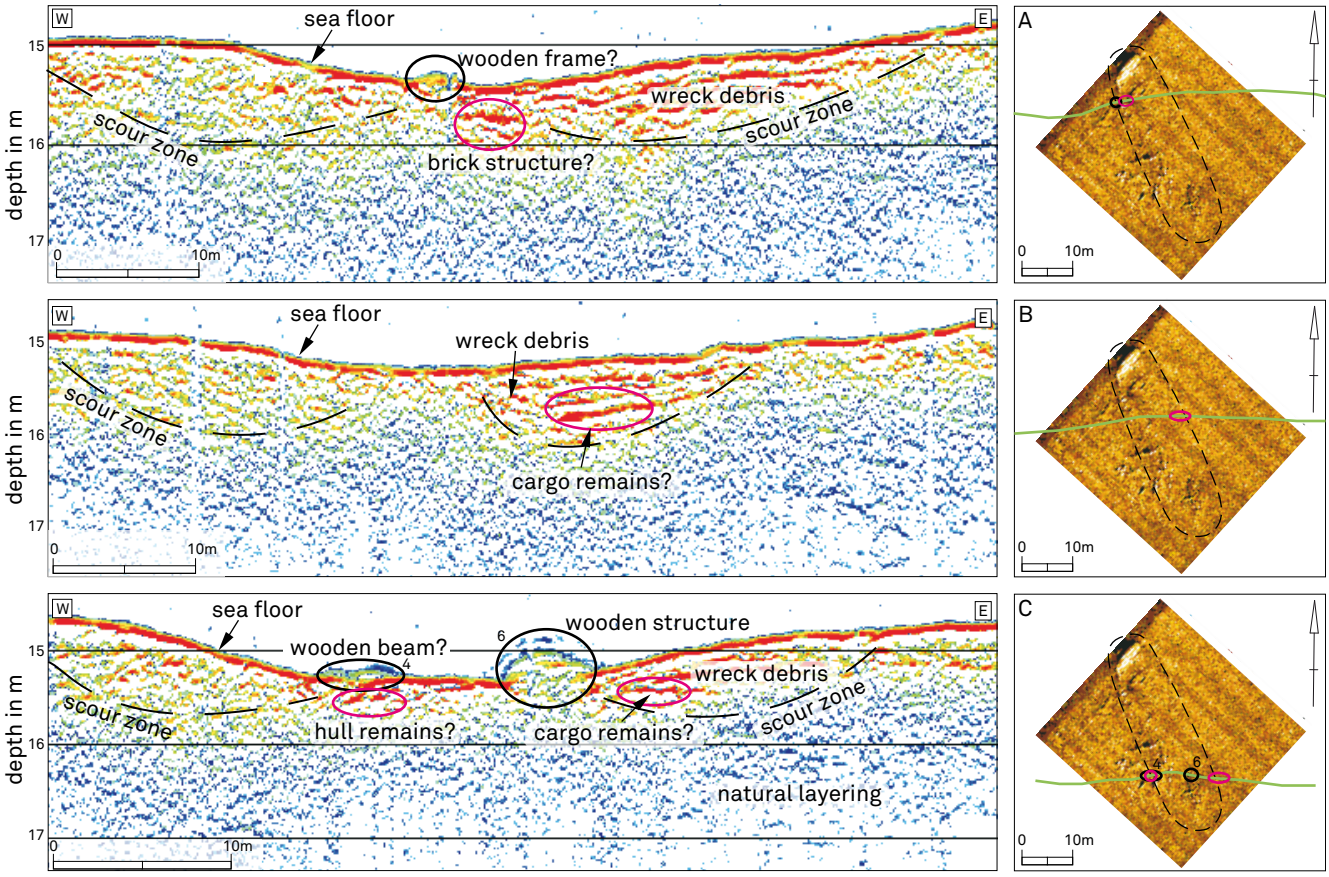

FIG. 11 **Seismic profiles crossing the wreck site roughly W-E. Black circles = exposed objects; red circles = buried wreck remains (numbers refer to fig. 9). Two scour fill zones, west (starboard) and east (port) of the wreck, can be observed. Discontinuous shallow reflectors on the east are most likely related to scattered wreck debris. The high-amplitude reflectors on the port side are probably related to the brick cargo (profiles B & C). Possible small hull remnants are observed on the starboard side (profiles A & C). Exposed objects are seen either as large diffractions (profile C) or as small side-reflections (profiles A & C).**
Seismische profielen dwars door het wrakgebied (O-W oriëntatie). Zwarte cirkels = uitstekende objecten; rode cirkels = begraven wrakfragmenten (cijfers verwijzen naar fig. 9). Twee uitschuringszones zijn te zien, resp. ten westen (stuurboord) en ten oosten (bakboord) van het wrak. De zwakke, ondiepe reflectoren in het oosten zijn waarschijnlijk afkomstig van verspreide wrakresten. De sterke reflectoren aan bakboordzijde zijn waarschijnlijk in verband te brengen met restanten van de bakstenen lading (profielen B & C). Mogelijke kleine resten van de scheepsromp zijn te zien aan stuurboordzijde (profielen A & C). Objecten op de zeebodem zijn duidelijk waarneembaar, ofwel als grote diffracties (profiel C) ofwel als kleine (soms nauwelijks waarneembare) zijreflecties (profielen A & C).

58 Quinn *et al.* 1998; Missiaen 2010.

59 Arnott *et al.* 2005.

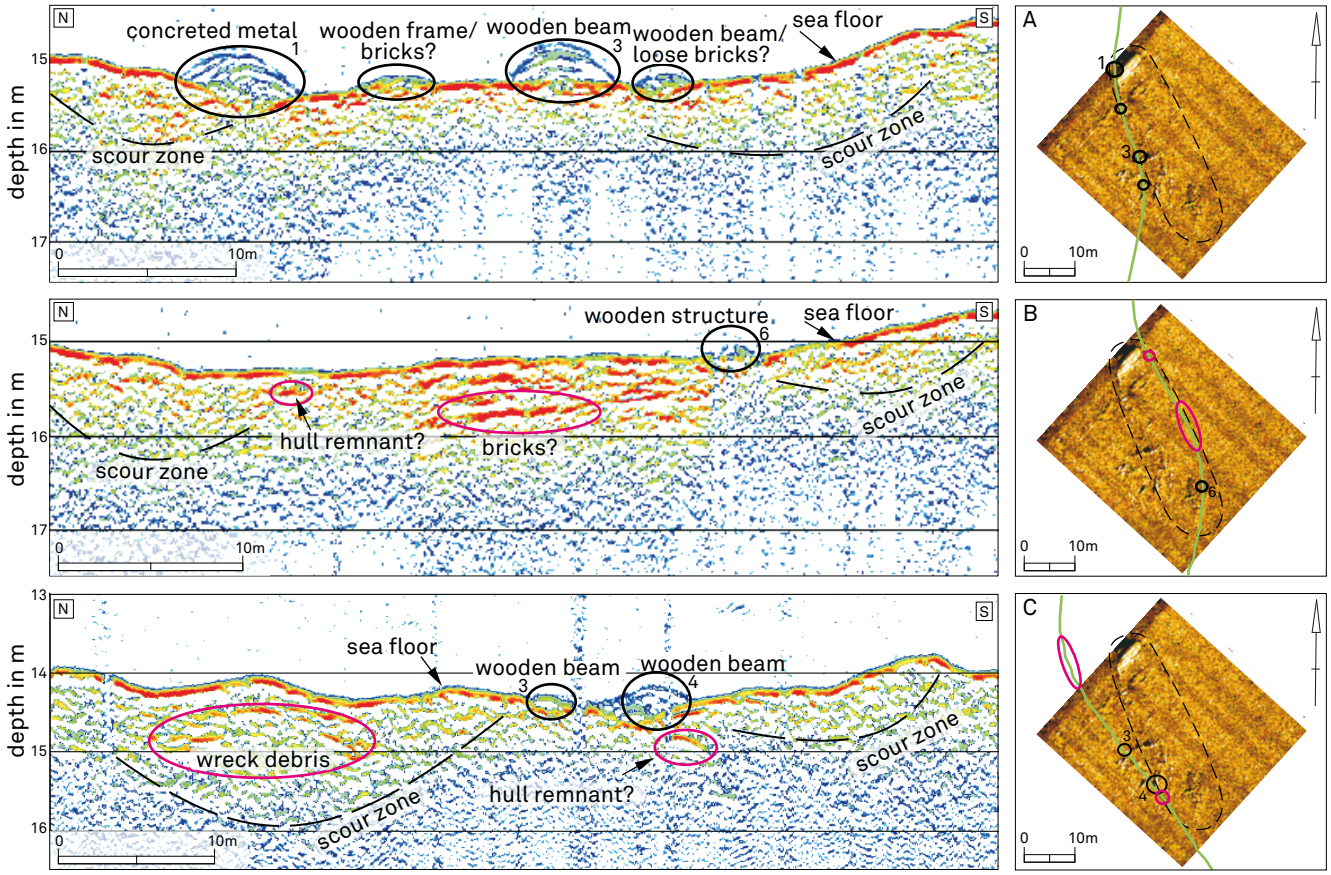

FIG. 12 Seismic profiles crossing the wreck site roughly N-S. Black circles = exposed objects; red circles = buried wreck remains (numbers refer to fig. 9). The high-amplitude reflectors on the port side are probably related to the brick cargo (profile B). Zones with discontinuous, shallow reflectors are most likely related to scattered wreck debris (profile C). Possible small hull remnants are observed near the stern and bow (profiles B & C). Exposed objects are seen either as large diffractions (profile A) or as small side-reflections (profiles B & C).
Seismische profielen doorheen het wrakgebied (N-Z oriëntatie). Zwarte cirkels = uitstekende objecten; rode cirkels = begraven wrakfragmenten (cijfers verwijzen naar fig. 9). De opvallend sterke reflectoren aan bakboordzijde zijn waarschijnlijk in verband te brengen met restanten van de bakstenen lading (profiel B). Zones met zwakke, ondiepe reflectoren zijn waarschijnlijk afkomstig van verspreide wrakresten (profiel C). Mogelijke kleine resten van de scheepsromp zijn te zien nabij de achtersteven en boeg (profielen B & C). De aanwezigheid van verscheidene objecten op de zeebodem is duidelijk, ofwel als grote diffracties (profiel A) ofwel als kleine (soms nauwelijks waarneembare) zijreflecties (profielen B & C).

5.1 Exposed objects and sediment cover

Comparison of the seismic profiles with the side-scan and multibeam data and the recent (2010) diving results revealed a general good agreement. Exposed objects on the sea floor stand out clearly on the seismic data as large hyperbolic diffractions (e.g. fig. 11C object 6 & fig. 12A objects 1 and 3). Even if the objects are located a few meters away from the seismic line they often remain visible as small side-diffractions (e.g. fig. 11C object 4 & fig. 12B object 6). In many cases the large diffractions yielded an acoustically transparent zone directly beneath the protruding objects, thereby locally masking the internal structure. Interpretation of the subbottom in these areas was therefore impossible.

The seismic data do not show any indication of a soft mud cover at the wreck site. In general the seabed reflection of the low-frequency data (10 kHz) is marked by relatively high amplitudes indicating a sandy or sandy-silty bottom. This is confirmed by the high-frequency data (100 kHz) which show little or no penetration at all below the sea floor (max. a few decimeters). The diving investigations in June 2010 indicated the presence of silty seafloor sediments. However, keeping in mind the vicinity of the dumping site of dredged material and the rapid changes in sedimentation that were previously observed, it is expected that the sediment cover is highly variable and the situation discussed here only presents a 'snap shot' in time.

5.2 Starboard side

The starboard side of the wreck is generally marked by a chaotic seismic image lacking clear internal stratification. Also the adjacent area towards the west shows little indication of any substantial wreck remains. Towards the stern a few short, high-amplitude reflectors are observed at a depth of roughly 30 cm bsf (fig. 11A). These could be related to the northern edge of the brick structure observed during the 2010 diving investigations. Strangely enough the profiles just to the south (fig. 11B) do not show any clear indication of the exposed brick cargo.

West of the starboard side the subsurface shows a chaotic shallow infilling stratigraphy, with a maximum depth of 1.2 m (fig. 13). The infilling zone extends up to 25-30 m from the wreck, beyond the shallow depression in the seabed that surrounds the wreck site. Possibly it can be linked to scouring processes when the wreck was still (partly) exposed. Locally the infill sequence is increasingly marked by short and discontinuous shallow reflectors. Most likely these can be linked to sediment layers which contain an increased amount of fine wreck debris (such as small wooden fragments). This is mainly observed in two small areas off the stern and bow of the wreck (fig. 13). Their location seems to correspond to the typical double-scour marks for wrecks oriented perpendicular to the tidal current[60].

5.3 Port side

The port side of the wreck is often marked by a number of short, strong and shallow reflectors (figs. 11B-C & 12B). It is likely that this marked stratification can be linked to the cargo remains (bricks). It also confirms the excavation results from 2000 where locally buried layers of bricks were encountered (trench 2)[61]. The continuation of some reflectors east of the wreck could be due to the inclination which caused the cargo to be spilled outside the wreck on the port side. Towards the east the reflectors become weaker and discontinuous which seems to point towards more scattered wreck debris. The stratification often becomes more chaotic in the previously excavated areas which could be due to the disturbance in these trenches.

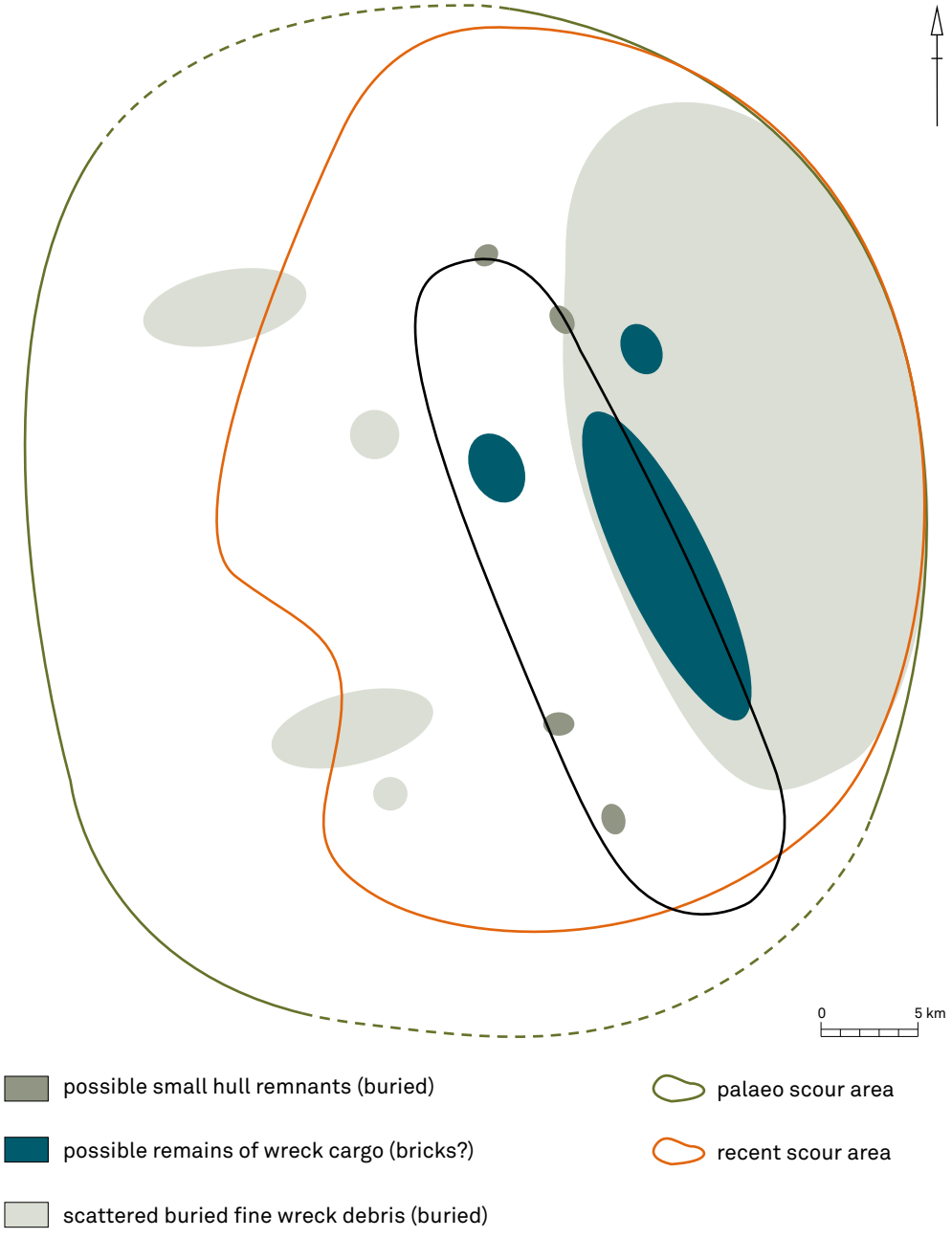

FIG. 13 **Tentative interpretation map of the wreck site area, showing the distribution of buried cargo remnants, wreck debris and scour fill zones based on the seismic data. The (supposed) wreck location is marked by the black line.** ***Voorlopige interpretatie van het wrakgebied, gebaseerd op de seismische data, met de verspreiding van begraven wrakresten (inclusief lading) en uitgeschuurde zones. De (vermeende) locatie van het wrak is aangegeven met een zwarte lijn.***

60 Quinn 2006.

61 Hildred (ed.) 2001.

East of the port side the shallow geology is marked by an infilling stratigraphy with discontinuous reflectors (fig. 11). Most likely these reflectors can be linked to sediment layers containing various wreck debris. The infill sequence has a maximum depth of 1.2 m and extends up to 15-20 m from the port side (fig. 13). The latter is probably a direct result of the inclination of the wreck, which caused the wreck debris to be spilled over a large distance on the port side. The eastern boundary coincides roughly with the limit of the shallow depression in the seabed that surrounds the wreck (fig. 13). Similar to the western starboard side, most likely also this eastern infilling zone can be linked to scouring processes when the wreck was still (partly) exposed.

5.4 Stern and hull remains

On the seismic profiles crossing the stern no clear evidence was found of any significant buried remains of the hull. This was largely due to the fact that the exposed remains of the stern (and possibly also the nearby cannon) caused large diffractions completely masking the subbottom structure (e.g. fig. 12A feature 1). On some profiles a short sharp reflector or diffraction was observed at shallow depth (< 0.5 m) (figs. 11C & 12B-C) but it remains uncertain whether this is actually related to small hull remnants or to scattered cargo remains. The frequent proximity of exposed objects on the seafloor suggests that in some cases we could be dealing with some buried side extension of these objects.

5.5 Deeper stratification

The deeper stratification, related to deposition before the wreckage, is very weak and almost entirely lacking in the area. In most cases the seismic data are marked by a transparent and/or chaotic seismic facies without any clear layering. Occasionally a few short, discontinuous reflectors can be observed, often at a depth between 1 and 2 m bsf (Fig. 11C). It is not clear to what extent these may be linked to the shallow Holocene sedimentary units described in section 2 or to the clay and shell-rich layers described in the 1985 & 2000 diving reports in section 3. As stated before, this lack of internal (natural) stratification is most likely due to a combination of a relatively hard sandy-silty bottom and the presence of shallow gas which will reflect and disperse most of the acoustic energy.

Summary and conclusions

The results of successive diving operations and acoustic investigations indicate that very little remains of the ship. The superstructure seems to have disappeared completely, and only scattered remnants have been preserved. The wreck is oriented NW-SE and lies inclined towards the port side. The most noticeable structural feature on the seabed seems to be related to the sternpost. It seems plausible that the inclination of the ship may have caused a more pronounced erosion of the higher - and therefore more vulnerable - starboard side. Diving surveys in 1993 and 2000 indicate that the port side of the stern seems to be preserved over a distance of 12 m, but no trace of this was found during the 2010 diving surveys.

The various excavation works indicate sandy or sandy-silty deposits with thick clay intercalations and locally hard shell-rich layers, down to a depth of roughly 2 m. The uppermost deposits often consist of a relatively thin layer of silty sediments. Most likely this soft sediment cover can be linked to the nearby located dumping site of dredged material. The depth of the encountered wreck remains varies between 0.5 and 2 m bsf. A lot of the artefacts were found buried in a relatively thin, clay-rich layer towards the bottom. This layer possibly represents the seafloor level at the time of wrecking.

The diving surveys prior to 2010 had mainly been focused on the area surrounding the stern, where almost all of the finds were recorded. In 2010 however for the first time structural remnants including large wooden beams (and cross-beams) and wood concretions were observed near the bow. This seems to agree with the previous diving surveys which suggested that the structural remains are dipping into the bottom towards the southeast, implying that the bow section was (at that time) covered with sediments[62]. It indicates that the site is subject to rapid and significant changes in sedimentation and erosion. Furthermore it cannot be excluded that some wreck remains may have disappeared or (partly) been destroyed due to trawling nets, possibly also by wreck hunters.

Side-scan sonar and multibeam data obtained in 2009 only show small wreck fragments protruding above the seabed, often related to the sternpost and various long timbers and/or cannons. Very high resolution seismic data acquired in 2010 indicate scattered buried wreck remains, largely related to the brick cargo. The ship's wooden structure seems to have largely disappeared, and no indications were found of significant structural remains of the hull. The location of the buried wreck debris seems to confirm the tilted position of the wreck. Locally the internal stratification was obscured by large diffractions.

Close comparison of the different data (seismic, side-scan, multibeam, diving) indicates a general good agreement. Most of the exposed features observed during the 2010 diving surveys correspond well with prominent seabed features on both the 2009 side-scan & multibeam data as well as the 2010 seismic data. A few seabed features, among which the rectangular brick structure towards starboard, were only observed during the diving survey. The seismic data however suggest the presence of buried remains of this brick structure. Together with previous diving observations this further confirms that the wreck site is subject to variable (and fast changing) sedimentation.

The area surrounding the wreck shows a shallow infilling stratification. Most likely this is a result of scouring processes when the wreck was still (partly) exposed. The infilling sequence is locally marked by weak, discontinuous reflectors which are probably related to sediment layers containing some amount of fine wreck debris. These reflectors are most pronounced east of the wreck, most likely due to the inclination of the wreck which caused a lot of the contents to be spilled outside the port side.

62 Gawronski & Kist 1984.

In the following years further diving surveys will be carried out by the Flanders Heritage Agency. These results should help to clarify the still remaining uncertainties (for instance the precise structure, distribution and depth of the brick cargo). Accurate georeferencing and detailed description of the current remains on the seafloor, and where possibly also buried, will hopefully lead to a full understanding of this 18th-century wreck site.

Acknowledgements

The captains and crews of the *Big Game* and *Last Freedom* are gratefully acknowledged. The authors would furthermore like to thank Wim Versteeg and Koen De Rycker for their assistance during the seismic data acquisition.

Samenvatting

Geïntegreerd assessment van het begraven wrak van de Nederlandse Oost-Indiëvaarder *'t Vliegent Hart*

Op 3 februari 1735 verging het VOC-schip *'t Vliegent Hart* vlak voor de kust van Zeeland. Het schip, dat geladen was met hout, bakstenen, ijzer, buskruit, wijn en geldkoffers, verging met man en muis. In 1736 werd tijdens een duikcampagne heel wat materiaal gelicht, waaronder een kanon, koper, lood, scheepsuitrusting, linnen, flessen wijn en munten. Het wrak bleek toen al voor een groot deel verwoest, waarschijnlijk door opeenvolgende winterstormen. Hierna verdween het wrak uit de aandacht.

In 1981 kwam het wrak onder hernieuwde aandacht en vanaf 1982 werd gestart met een aantal bergingscampagnes. In 1983 werden delen van de achtersteven en de scheepsromp aan bakboordzijde in kaart gebracht, waarschijnlijk afkomstig van het lager gelegen gedeelte van het schip. De bovenbouw leek grotendeels verdwenen. Het wrak zou noordwest–zuidoost georiënteerd zijn, en onder een hoek van 55 graden naar bakboordzijde overhellen. Er werden ook verschillende kanonnen en loden ballastrollen geborgen. In juli 1983 werd een complete, afgesloten kist met duizenden munten (gouden dukaten en zilveren realen) bovengehaald.

In 1984-1985 werd de achtersteven tot 2 m onder de zeebodem getraceerd en vond men een deel van de kombuis alsook een fragment van een dubbele loden spuipijp. In de jaren nadien volgde een deel van de spantenconstructie en werd er materiaal opgedoken afkomstig uit de hutten van schipper en officieren. Naast kanonnen en houten balken trof men in 1993 ook talrijke loden ballastrollen en bakstenen aan. De meeste voorwerpen bevonden zich aan bakboordzijde, waarschijnlijk een gevolg van de helling van het schip. Tijdens de duikcampagnes in 2000 werd een deel van de scheepsromp bij de achtersteven uitgegraven. Aardewerk, loden rollen, flessen, munten, pijpen en scheepstuigage werden geborgen. Aan bakboordzijde trof men ook grote hoeveelheden bakstenen aan, op sommige plaatsen nog gestapeld in parallelle lagen.

In 2009 voerden het Renard Centre of Marine Geology (RCMG, UGent) en de Vlaamse Hydrografie respectievelijk side-scan sonar- en multibeammetingen uit. Op deze beelden valt meteen op dat de wrakresten voor het overgrote deel begraven liggen. Slechts een paar objecten steken geheel of gedeeltelijk boven de zeebodem uit. Het meest opvallende object is waarschijnlijk gerelateerd aan de achtersteven en komt een paar tientallen cm boven de omringende zeebodem uit. Daarnaast kunnen ook een aantal langwerpige voorwerpen op de bodem onderscheiden worden die duiden op (scheeps)balken of mogelijk een kanon.

Recente duikcampagnes werden uitgevoerd door het agentschap Onroerend Erfgoed in de zomer van 2010. Voor het eerst werden wrakresten (waaronder verschillende balken en dwarsbalken) waargenomen in het zuidoosten. De ligging en constructie van deze balken wijzen op het uiteinde van het schip, met name de boeg. Twee uitstekende planken en een opgehoogde concretie van metaal en hout vormen de enige indicatie van de achtersteven. Vlakbij werd een half begraven kanon aangetroffen. Verspreid over de wraksite werden diverse wrakresten, waaronder houten planken, losse bakstenen en flessenbodems waargenomen. De meest in het oog springende waarneming was een grote structuur van lineair gestapelde bakstenen aan stuurboordzijde. Naar het oosten toe (bakboord) wordt de structuur onregelmatiger en steeds meer fragmentarisch. Over het algemeen vertonen de duikresultaten uit 2010 goede overeenkomsten met de side-scan- en multibeamgegevens.

Om een beter beeld te krijgen van mogelijke begraven wrakrestanten werden seismische surveys uitgevoerd in 2009 en 2010 door het RCMG. De seismische beelden geven aan dat ook onder de zeebodem slechts zeer weinig overblijft van het wrak. De houten structuur (romp) lijkt zo goed als helemaal verdwenen, op enkele (mogelijke) kleine restanten na. Begraven wrakresten, waaronder restanten van de bakstenen lading, komen voor aan bakboord, waarschijnlijk een gevolg van het overhellen van het schip waardoor de inhoud naar bakboordzijde is gevallen. Ten oosten van het wrak strekt zich een uitgebreide zone uit met verstrooid wrakpuin, in tegenstelling tot de westzijde waar slechts twee kleine zones wijzen op mogelijke wrakresten. De zeebodem op de wraksite zelf wordt gekenmerkt door een recente, ondiepe uitschuring. Verder weg van het wrak werden ook sporen gedetecteerd van een oudere ondiepe uitschuring, die vermoedelijk dateert van de tijd toen het wrak nog gedeeltelijk boven de bodem uitstak en het sediment rondom werd weggeschuurd.

De resultaten van de diverse duikcampagnes en het akoestisch onderzoek (side-scan sonar, multibam, seismiek) tonen duidelijk aan dat de wraksite onderhevig is aan snelle veranderingen in sedimentatie en erosie, waardoor het uitzicht op relatief korte tijd (enkele weken tot maanden) volledig kan veranderen. Daarnaast is het niet uitgesloten dat vissersnetten, en mogelijk ook wrakduikers, bijkomende schade aan de wraksite hebben berokkend. Verdere duikcampagnes van het agentschap Onroerend Erfgoed zijn gepland voor de komende jaren. Deze nieuwe resultaten moeten helpen om de resterende onzekerheden weg te nemen (bijvoorbeeld de precieze structuur, verspreiding en diepte van de bakstenen lading). Accurate georeferentie en registratie van de wrakresten op de zeebodem, en mogelijk ook begraven, moeten uiteindelijk toelaten om een compleet inzicht te krijgen in dit unieke 18de-eeuwse wrak.

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