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The significance and contribution of marine aggregates

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Abstract: Marine aggregates off southern Britain commonly originated in fluvial environments during phases of lower than present sea level in the Quaternary Period. Aggregate extraction from such fluvial terrace and channel infill deposits has revealed evidence for low sea levels, including faunal remains, peat deposits and, most significantly, flint hand axes. In addition, more recent maritime and aviation remains are occasionally recovered in aggregate cargoes, including timbers, cannon balls and wartime aircraft parts. Artefacts found either in dredged cargoes or at the receiving wharf or other landing point are recorded through a reporting protocol agreed between BMAPA and English Heritage (EH). This involves the participation of dredger crews, wharf and processing plant staff, industry management, archaeological specialists and officials in English Heritage. The protocol, underpinned by a partnership between BMAPA and EH, a joint Guidance Note and a high standard of archaeological investigation and feedback on finds, has been and continues to be a great success.

The significance of marine aggregates as an archaeological repository

The origin and formation of marine aggregates off southern Britain

Marine aggregates are sands and gravels of a quality useful for civil engineering and coastal defence which lie on the seabed of the continental shelf surrounding the British Isles. Their temperate marine setting off southern Britain commonly contrasts with a cold climate terrestrial geological origin and in order to understand aggregate deposit formation events during the Quaternary Period (approximately the last 2 million years) must be studied. Offshore surveys by both the UK Government (eg James *et al* 2011) and by the marine aggregates industry (eg Bellamy, 1998 and 2011 in press) have revealed that sands and gravels are commonly found within infilled river valleys, now submerged on the seabed. During episodes of lower than present global sea level in prolonged cold stages of the Quaternary, rivers draining an arctic-type landscape extended onto the continental shelf and deposited sands and gravels over their floodplains, typically reaching thicknesses exceeding 5 m (Figure 1). Rivers draining the English Midlands occasionally carried glacial meltwater whilst those of southern England and the present English Channel were supplied entirely by snow and ground ice melt in periglacial environments akin to Arctic

Canada. Repetition of cold stages with intervening and relatively brief interglacials over the past 2 million years led to complex fluvial cut, fill and terrace sequences which record a long history of sedimentation on the continental shelf off southern Britain (Figure 2). This clearly implies a significant prehistoric archaeological potential for such deposits, especially as the sediments are simply the downstream equivalents of deposits found in present river valleys on land, which themselves are commonly notable for their Palaeolithic archaeological content (eg Wymer 1999).

The following palaeovalleys contain marine aggregates:

- The ancestral River Yare off Great Yarmouth
- The ancestral Thames and its tributaries off the coast of Suffolk and Essex
- The “Channel River” and its tributaries in the eastern English Channel
- The ancestral Arun off West Sussex
- The Solent River and associated streams east and west of the Isle of Wight

Investigation of the prehistoric archaeological potential of marine aggregate deposits has increased in recent years (see for example Firth, 2011). Tizzard *et al* 2011 investigated sediments infilling the submerged Yare Valley off Norfolk and established a model of depositional events using seismic and sample data from dredging licence areas. Furthermore, age estimates using the OSL (Optically Stimulated Luminescence) technique on sediments from the same area show that gravel sedimentation occurred within the Middle Palaeolithic period, with dates of 207,000 – 283,000 years before present established from fluvial gravelly sands in 25 m water depth.

In addition, reconstructions of cut and fill events using high resolution shallow seismic and sample data from other palaeovalleys (eg Bellamy 1995; Emu Ltd and The University of Southampton, 2009) and emerging age estimates from some of these localities strongly suggest a similarly long evolutionary history and hence a strong potential for in situ or at least locally derived Palaeolithic remains. This deduction is supported by the absence of glaciation and its erosive effects in the southern North Sea basin since the Anglian (Elsterian) stage over 450,000 years ago and the lack of any glaciation or fluvio-glacial activity in the English Channel region, fluvial sedimentation having occurred here exclusively in nival periglacial or early temperate environments before marine transgression.

These factors combine to present a fascinating sedimentological record and tantalising archaeological potential off southern Britain, unaffected by the disruptive effects of recurrent glaciations which have dominated Quaternary geology in the central and northern British Isles. This potential has recently been realised in dramatic fashion by the documented recovery of 121 flint artefacts, including 36 handaxes, from several dredged aggregate cargoes taken from a licence area south of the last, Weichselian, glacial limit (Figure 3). The site, Licence Area 240 off Great Yarmouth, is located over part of the former Yare Valley floodplain and the artefacts were found at a receiving wharf in the Netherlands following offloading by the dredger. These finds, many of which are in pristine condition, provide the first direct evidence of human presence *in situ* on the UK continental shelf at times of lower than present sea level and a thorough investigation is continuing. The OSL age estimates referred to above provide a sound basis for the interpretation of these finds, the dated sediment samples being taken from the same localities as the handaxes.

Allied to these exceptional and unusual finds, the more common recovery of terrestrial faunal remains in dredged cargoes and the presence of temperate climate peat deposits beneath the seabed also demonstrate terrestrial conditions and hence potential human presence. Well preserved bones, teeth and antlers are also of considerable intrinsic interest (Figure 4) and permit a vivid reconstruction of the long periods when the entire southern North Sea and English Channel were subaerially exposed, linking the British landmass to continental Europe.

During the last marine transgression, the plains linking Britain and Europe were rapidly submerged, relatively small rises in sea level inundating large areas of land. In high energy coastal and shallow marine environments, surficial reworking of fluvial sediments took place as the shelf adjusted to the onset of fully marine conditions with associated tidal currents and storm waves. There is therefore the additional potential for finds in a primary context within submerged gravelly coastal deposits, analogous for example to those in southern England at Slindon in West Sussex (Roberts 1998). In addition, scattered faunal and Palaeolithic remains in secondary contexts are likely, after reworking during marine transgression.

Marine aggregates as a source of maritime and aviation remains

The complete submergence of the continental shelf by approximately 7000 years ago clearly precluded human occupation but began the maritime archaeological period. The most common finds associated with this period are shipwrecks and isolated wreckage. Charted wrecks are carefully avoided by the marine aggregates industry, not only to preserve their integrity but also to ensure safety at sea and to avoid damage to dredging vessels. However, uncharted or small isolated remains exist which cannot be easily detected by pre-dredge seabed surveys and it is these that can be recovered unintentionally in dredged aggregate cargoes. The most common finds are cannon balls of various sizes and a wide variety of cargo, although timbers and even domestic items such as hallmarked silver cutlery and candle holders have been recovered.

Aircraft parts are occasionally recovered in dredging licence areas from uncharted crash sites, these most commonly relating to WWII. These have included aluminium airframe fragments, engine parts, guns and ammunition. A human thigh bone dating from the Battle of Britain was recovered in 2007 in association with the remains of a German Junkers 88 from a dredging area east of Southwold, Suffolk. An American Flying Fortress which ditched off Great Yarmouth was unintentionally dredged in 2006 and a pistol, flying helmet and machine gun were recovered at the wharf (Figure 4). The aircraft had sunk almost intact and in the 65 years since its loss had become buried in mobile sand. It is likely that other uncharted and partly buried remains exist in dredging licence areas some of which will no doubt be unintentionally recovered in the dredged cargoes of the future.

The contribution of the marine aggregate industry to the development of marine archaeology

Making and recording finds

The preceding discussion has reviewed the great archaeological potential of marine aggregates, highlighting the wide variety of finds recovered in recent years as part of dredging and shore-side processing activity. The recovery and recording of this material is only possible with the co-operation of the industry, most importantly the crew on the dredgers and staff at the receiving wharves who routinely handle the sediments in their natural state before they enter the processing plants and are then delivered as aggregates into the construction industry.

To consolidate this co-operation, the industry, in partnership with English Heritage, published a Guidance Note in 2003 entitled *“Marine Aggregate Dredging and the Historic Environment: assessing, evaluating, mitigating and monitoring the archaeological effects of marine aggregate dredging.”* This was followed in 2005 with a Protocol for the reporting of finds of archaeological interest on dredgers and at the wharf, again published by the industry in partnership with English Heritage (Figure 5).

The 2003 Guidance Note

The Guidance Note aims to provide practical guidelines on dealing with archaeological issues for marine aggregate developers, consultants, curators, contractors and industry regulators and built on the already published Code of Practice for Sea Bed Developers produced by the UK's Joint Nautical Archaeology Committee. The Note was prepared by Wessex Archaeology in consultation with the British Marine Aggregate Producers Association (BMAPA) and English Heritage. Topics covered included:

- the character and importance of the historic environment
- the regulatory framework
- possible effects of aggregate extraction on the marine historic environment
- the nature of and need for archaeological advice by companies applying for dredging licences
- how aggregate extraction proposals should be properly assessed
- sources of archaeological data
- techniques for the evaluation of seabed sites
- mitigation and monitoring measures should permission to extract aggregates be given to an operator

Since 2003, the Guidance Note has become a standard reference for all environmental impact assessments for dredging licence applications with the approaches highlighted now widely accepted as best practice. The Guidance and subsequent Protocol have provided a model for archaeological management in other industry sectors, notably the offshore wind industry and, most recently, with some locally based fishing interests.

The 2005 Protocol for reporting finds of archaeological interest

The success of the Guidance Note led English Heritage and BMAPA to discuss how best to encourage the reporting of archaeological finds made on dredgers and at wharves receiving their cargoes. Rather than have different protocols in separate licence conditions for each of the operating companies, BMAPA and EH decided to devise a single protocol applicable to all dredging areas, vessels and wharves irrespective of which company operated them. The Protocol was designed to promote awareness in the industry of the high archaeological potential of marine aggregates. In addition the Protocol set out an approach to the reporting, handling and stabilising of any finds made on ships and at the wharf which all companies in the UK industry have adopted. With the agreement of the companies, the single Protocol was intended to ensure consistency of approach and to encourage the participation of all involved in the running of the industry. Most importantly, the aim of the Protocol is to reduce any adverse effects of marine aggregate dredging on the historic environment by enabling those working at sea and at wharves to report their finds conveniently and effectively without undue disruption to their tasks. Guidelines for indentifying finds are given in the Protocol be they composed of rubber, plastic, metals, bone, wood, stone, pottery, brick or peat and clay.

The Protocol works by establishing a line of communication for those involved. Finds either in cargoes or on stockpiles are reported to a Site Champion on the ship or wharf who then reports to a Nominated Contact acting for or representing the operator concerned, normally a member of the company's management team. The Nominated Contact then passes the details of the find to a specialist archaeological consultancy acting on behalf of English Heritage, currently Wessex Archaeology. Details of the dredging location, date, find made, photographs and name of the person making the find are passed by the company to English Heritage and their consultant. At the same time advice is provided to the industry on how best to stabilise finds in the period immediately after their discovery. Finds are collected by EH for further examination if they are particularly interesting or unusual.

Once the find is recorded, advice on the identification of the find and its seabed location is provided as well as how to conserve the find into the future. EH liaises with other archaeological authorities, the Receiver of Wreck (over possible find ownership) and the Crown Estate (as mineral owner) where necessary. Advice may also be given on measures to mitigate the effects of dredging on finds, where needed.

To encourage reporting of finds, which might otherwise go unnoticed or be destroyed in the processing plant, a poster was issued to ships and wharves displaying the diversity of possible finds and the means of reporting them (Figure 5). Staff from EH and their consultants regularly visit wharves to discuss archaeological issues with industry staff and presentations are given to raise awareness and to provide information on how to recognise finds and keep them safe. A DVD with similar information is provided to dredger crews because ship visits have proved more difficult to arrange due to operational constraints. In addition, a popular twice yearly newsletter is issued to the industry with updates on the Protocol Implementation Service and articles on selected aspects of marine archaeology. Thirdly, an annual report on the Protocol is published by BMAPA, The Crown Estate and EH. This contains detailed accounts of all of the finds made in a given year, their collective distribution and specific identification. A page is devoted to each find, including details on its characteristics and identification, with the finder and his/her ship or wharf named. The report is sent to all ships and wharves and is well received, having provided a strong sense of pride and ownership by all involved in implementing the Protocol.

To consolidate this success, shortly after the Protocol was introduced BMAPA and EH decided to award a small prize to the best find made by both a ship's crew and a receiving wharf for the year. A prize is also awarded for the most professional attitude to archaeology shown by a ship or wharf, irrespective of the type of finds made.

Concluding remarks

The acknowledgement that aggregate dredging can disturb or remove unknown archaeological evidence is tempered by the high priority the industry affords the subject as part of its routine operations. Whilst the archaeological sites themselves can be disturbed, their significance can be fully realised with the recovery of archaeological finds in aggregate cargoes, material which in many cases would otherwise never have been seen or appreciated, lying beneath the sea within seabed sediment. The protocol, now in its 6th year, has helped engender a keen interest in marine archaeology with those in the industry and is proving to be a success for all involved - operators, curators and regulators alike. The Guidance Note and Protocol are proving effective in minimising the impact the industry has on marine archaeology. As a result of the adoption of these measures, over 800 finds have been reported since 2005, many of which are highly significant and have prompted considerable interest and ongoing research, ranging from unravelling the record of prehistoric occupation on the continental shelf to tracing the origin of wartime wreckage.

A further benefit arising from the initiative is the potential for outreach, education and enhancing museum collections. Finds are frequently donated and lent by BMAPA member companies and EH for these purposes and help to illustrate the diverse submerged cultural heritage of the British Seas.

References

Bellamy, A. G., 1995 Extension of the British landmass: evidence from shelf sediment bodies in the English Channel. In Preece RC (ed.) *Island Britain: a Quaternary perspective*, Geological Society Special Publication 96, pp47-62

Bellamy, A. G., 1998 The UK marine aggregate dredging industry: an application of Quaternary geology. In Latham, J-P (ed.) *Advances in aggregates and armourstone evaluation*. Geological Society Engineering Geology Special Publication 13, pp 33-45.

Bellamy, A. G., 2011 (in press), Extracting marine aggregate resources from the Pleistocene Solent River east of the Isle of Wight. The 2010 Extractive Industry Geology Conference Proceedings.

Emu Ltd and the University of Southampton, 2009 Outer Thames Estuary Regional Environmental Characterisation. Report for the Marine Aggregates Levy Sustainability Fund.

Firth, A., 2011, 'Submerged Prehistory in the North Sea', in Catsambis, A., Ford, B. and Hamilton, D. (eds), *The Oxford Handbook of Maritime Archaeology*, New York, Oxford University Press, 786-808

James, J.W.C, Pearce, B., Coggan, R.A., Leivers, M., Clark, R.W. E., Plim, J.F., Hill, J. M., Arnott, S.H. L., Bateson, L., De-Burgh Thomas, A. and Baggaley, P.A., 2011 The MALSF synthesis study in the central and eastern English Channel. British Geological Survey Open Report OR/11/01 for the Marine Aggregates Levy Sustainability Fund.

Roberts, M. B., 1998 Middle Pleistocene sediments and archaeology at ARC Earham Quarry, Boxgrove, West Sussex, in Murton et al (eds) 1998, *The Quaternary of Kent and Sussex* Fld Guide Quat. Res. Assoc., pp 187 - 213

Tizzard, L., Baggaley, P.A and Firth, A. J., 2011 Seabed Prehistory: investigating palaeolandsurfaces with Palaeolithic remains from the southern North Sea. In Benjamin *et al* (eds) *Submerged Prehistory*, Oxbow Books.

Wymer, J., 1999 *The Lower Palaeolithic Occupation of Great Britain*, Salisbury, The Trust for Wessex Archaeology.