Diving in at the deep end: Getting started in marine geoarchaeology

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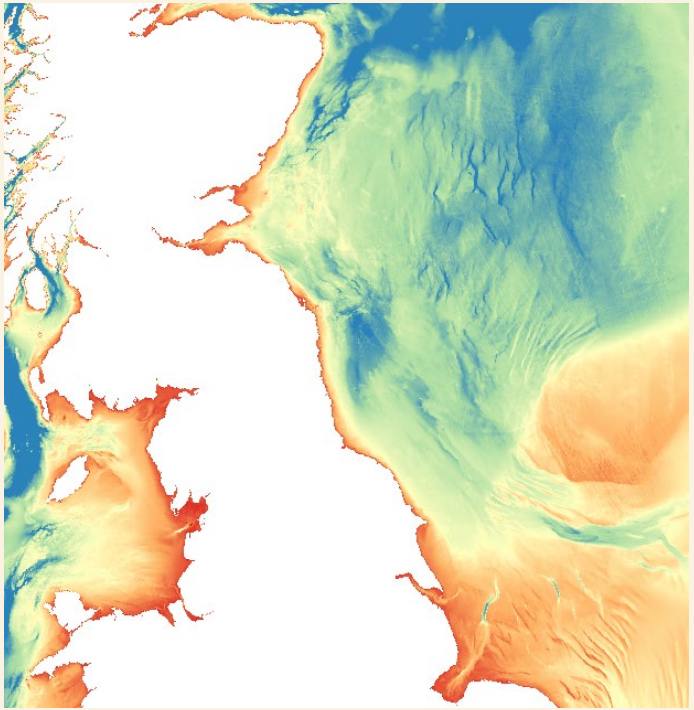
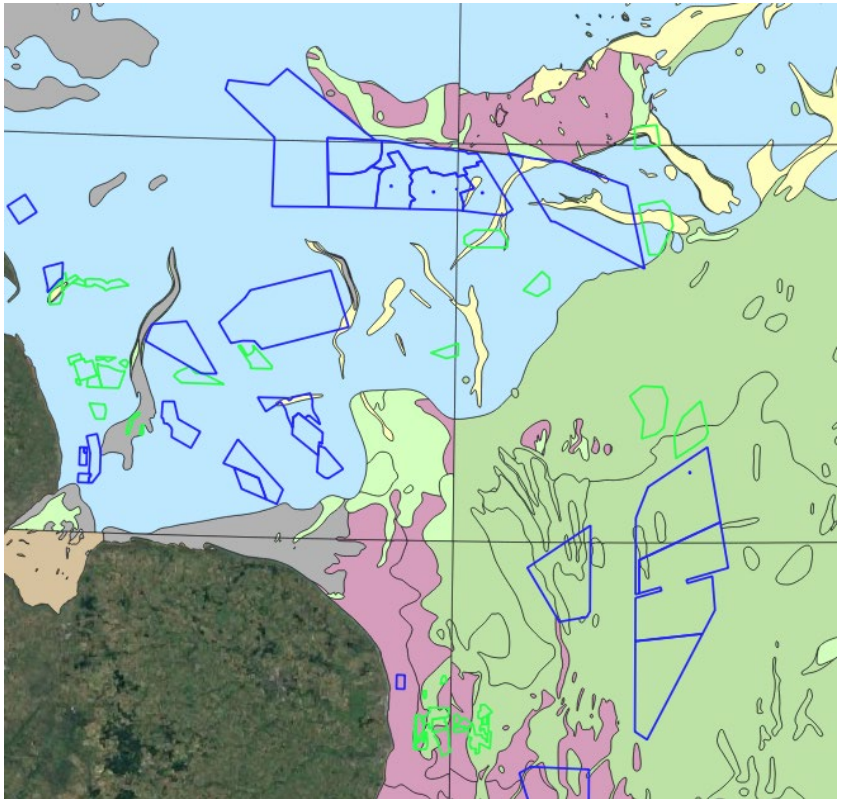


CIfA Geoarchaeology and Palaeoenvironment Network

Talk structure

- Why marine geoarchaeology matters
- Submerged landscapes
- Approaches to marine geoarchaeology
- Guidance and resources
- Some challenges

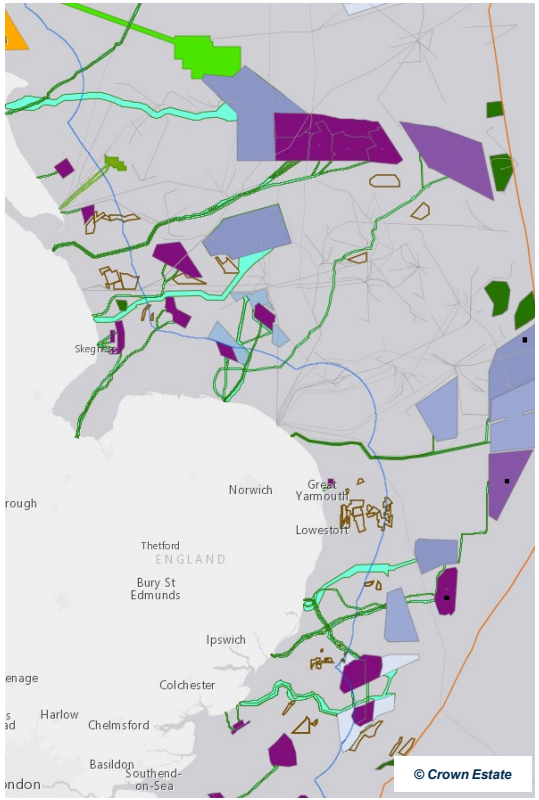


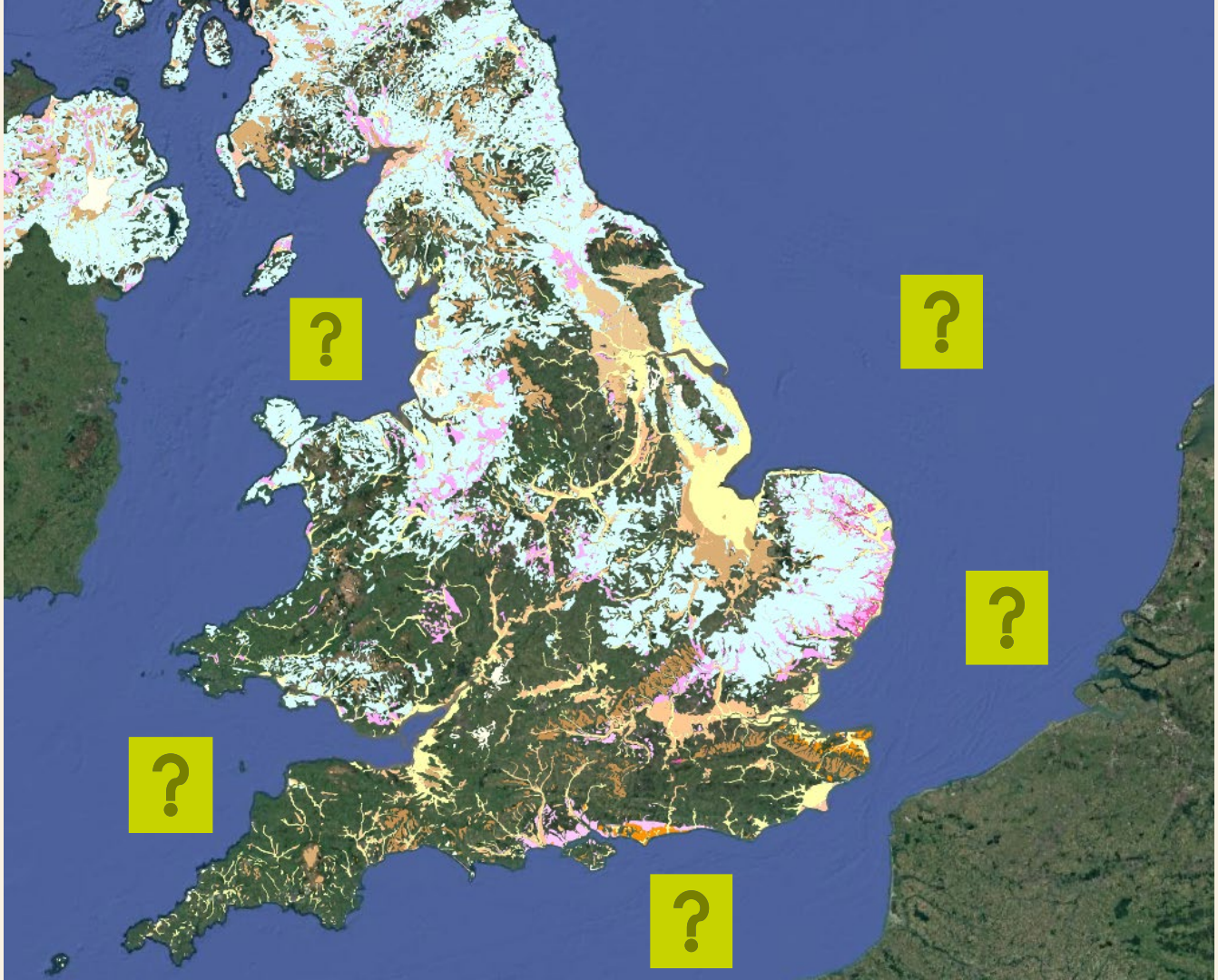
Why marine geoarchaeology matters

- **Understanding Lost Landscapes**
  - Reconstructs submerged prehistoric environments
  - Identifies ancient rivers, coastlines, and wetlands
  - Helps explain human migration and settlement patterns
- **Protecting Underwater Cultural Heritage**
  - Detects submerged archaeological sites and shipwrecks
  - Supports preservation of buried landscapes and organic remains
  - Reduces risk of adverse impacts during development of the seabed
- **Supporting Offshore Development**
  - Informs archaeological risk assessments/method statements
  - Supports offshore wind, cables and pipelines related to renewable energy
  - Contributes to environmental and regulatory compliance

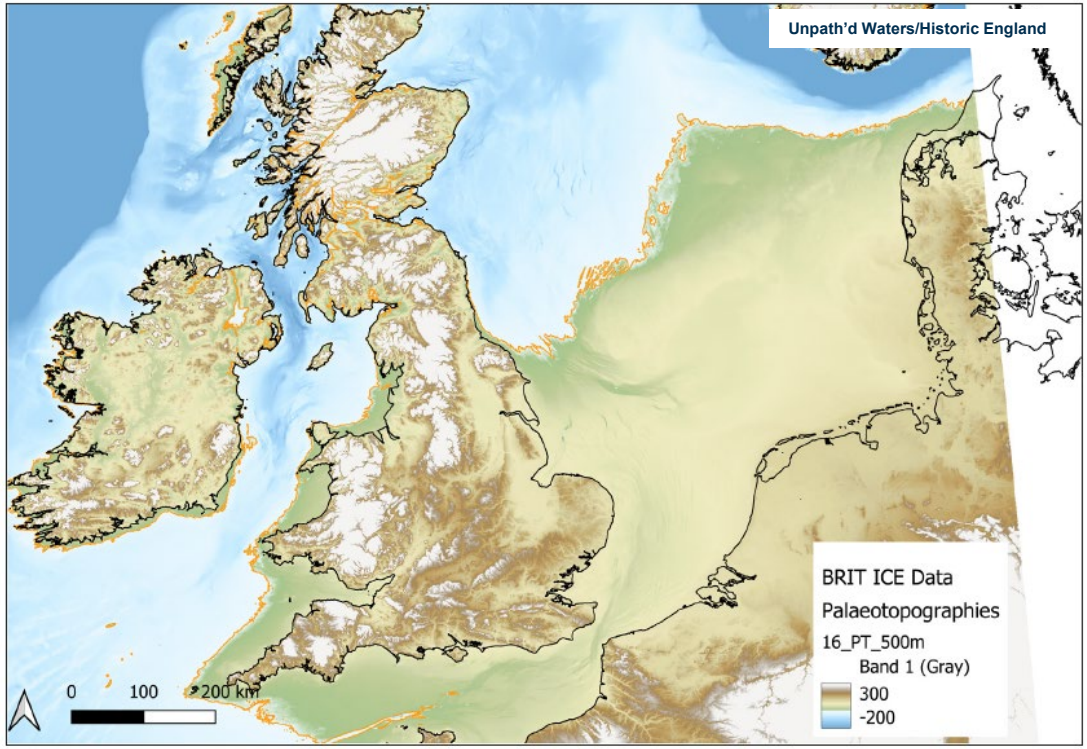
Marine development

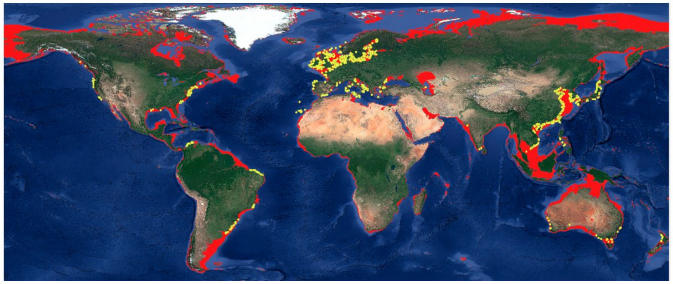
- **Impacts on the seabed from:**
  - Ports and harbours
  - Offshore wind and export cables
  - Offshore substations
  - Interconnector cables
  - Aggregate dredging
  - Coastal defence and flood protection (incl. beach replenishment)
  - Carbon capture and storage

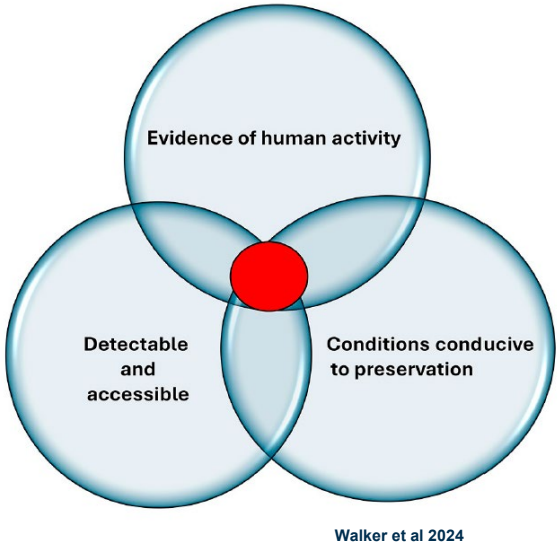




Submerged landscapes







Walker et al 2024

Evidence for submerged landscapes

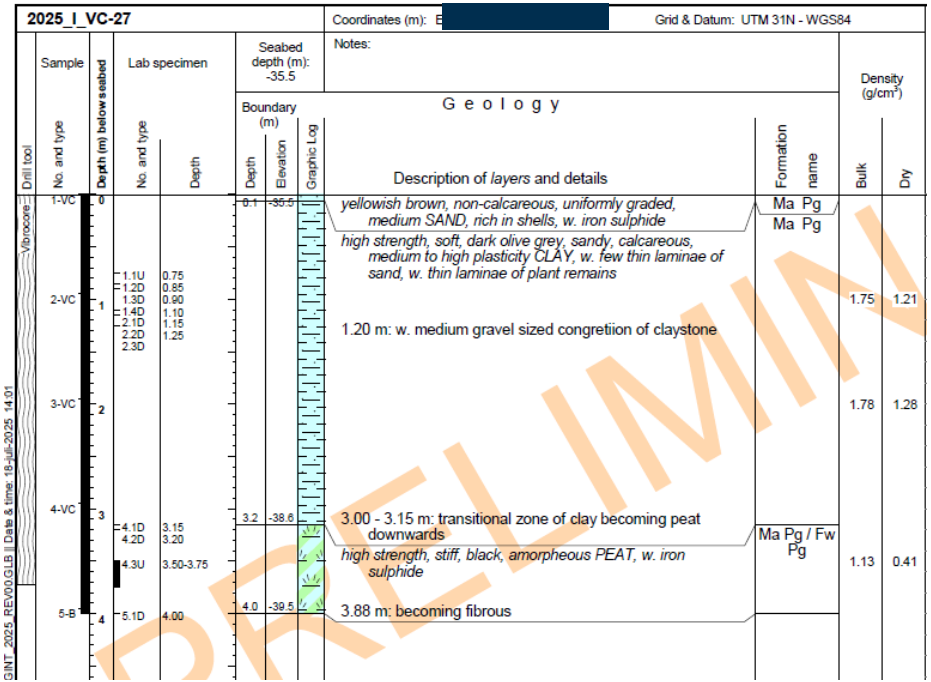
Evidence Type	What It Indicates	Typical Interpretation	Archaeological Potential	Palaeoenvironmental Potential
Peats	Former wetlands or marshes	Terrestrial environments preserving palaeoenvironmental remains	High	High
Organic Silts & Clays	Lakes, estuaries, floodplains	Low-energy terrestrial environments	Medium	Moderate
Wood & Root Horizons	Former land surfaces	Submerged terrestrial landscapes	Medium	Moderate
Buried Soils (Palaeosols)	Stable exposed ground surfaces	Potential occupation surfaces	High	Moderate
Fluvial Sands & Gravels	Ancient river channels	River systems and drainage networks	Medium*	Low*
Shells & Marine Sediments	Marine transgression	Sea-level rise and coastal flooding	Low	Low

Staged approach to geoarchaeological assessment

Stage	Description
Stage 1 Geoarchaeological review of geotechnical of logs	Desk-based review of geotechnical and geological data. Establish likely presence / absence / distribution of archaeologically relevant deposits. Identify deposits or samples for Stage 2 geoarchaeological recording.
Stage 2 Geoarchaeological recording of geotechnical samples	Target deposits or samples identified during Stage 1. Describe the sequences recovered and undertake deposit modelling (if appropriate). Interpret depositional environments (where possible). Identify if suitable deposits are present for Stage 3 assessment.
Stage 3 Palaeoenvironmental assessment	Sub-sample deposits of archaeological interest for paleoenvironmental assessment (e.g. pollen, plant macrofossils, foraminifera, ostracod and diatoms) and associated scientific dating. Provide an outline interpretation of the archaeological and palaeoenvironmental context. Make recommendations for Stage 4 analysis (where appropriate).
Stage 4 Palaeoenvironmental analysis	Full analysis of samples and additional scientific dating as specified in Stage 3, together with a detailed synthesis of the results, in their local, regional or wider archaeological and palaeoenvironmental context.
Stage 5 Publication	Publication of the results of Stage 1 to 4 works for submission in a peer reviewed journal, book or monograph, depending on the archaeological significance of the work.

Staged approach to geoarchaeological assessment

Stage 1 – Geotechnical log review

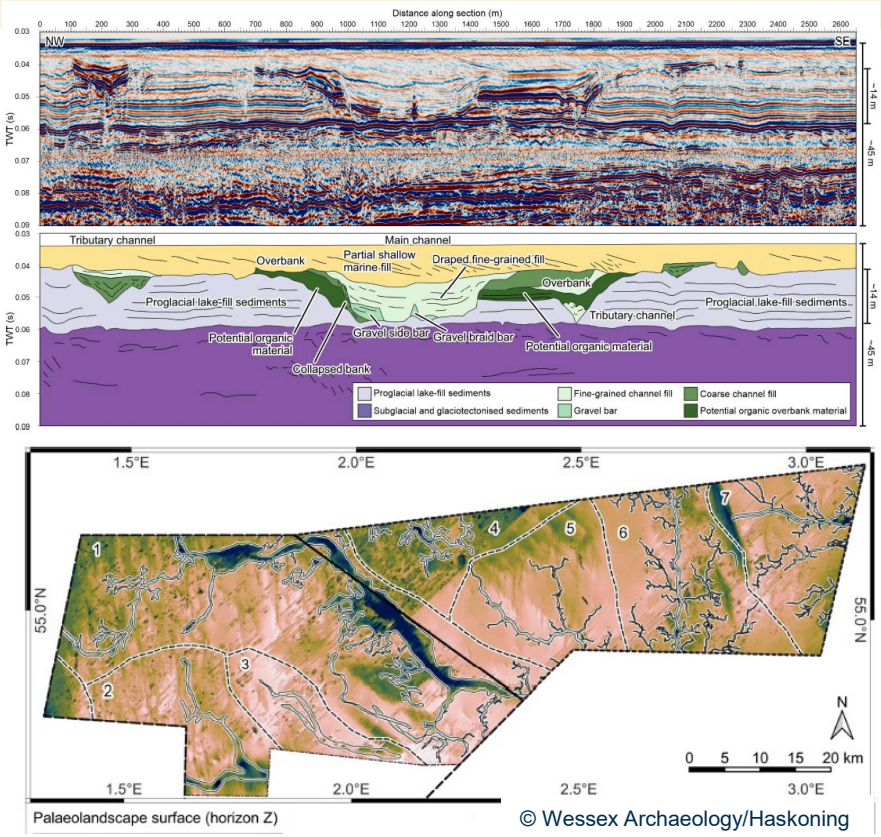


Stage 2 – Geoarchaeological recording

Vibrocore	Depth from (m bsf)	Depth to (m bsf)	Geoarchaeological description	Interpretation
2025_I_VC-27Arc	0.00	0.10	Firm yellowish grey fine SAND with frequent shell fragments and occasional whole shell (bivalves up to 30 mm). Gradual contact into:	Seabed sediments
	0.10	0.28	Soft to firm olive grey sandy clayey SILT with frequent shell fragments up to 20 mm. Diffuse contact into:	Estuarine alluvium
	0.28	0.86	Soft to firm olive grey clayey SILT with common sand beds up to 10 mm in thickness. Frequent shell fragments and occasional whole bivalves <10 mm. Gradual contact into:	Estuarine alluvium
	0.86	1.40	Firm olive grey clayey SILT with common fibrous plant remains and shell fragments (5-10mm). Diffuse contact into:	Estuarine alluvium
	1.40	2.00	Firm olive grey clayey SILT with occasional beds (<5 mm thick) of sand. Occasional shell fragments (<5 mm). Gradual contact into:	Estuarine alluvium
	2.00	2.53	Firm olive grey silty CLAY with frequent laminations, some sandy, <5 mm in thickness. Occasional fine shell fragments (<5 mm). Diffuse contact into:	Estuarine alluvium
	2.53	3.00	Firm dark greyish black (anoxic?) silty CLAY with common fine laminations (<5 mm). Frequent sandy beds (<5 mm in thickness). Diffuse contact into:	Estuarine alluvium
	3.00	3.15	Firm olive grey clayey SILT with frequent laminations, many of which are composed of SAND. Gradual contact into:	Estuarine alluvium
	3.15	3.26	Stiff dark olive grey very organic silty CLAY with frequent very small shell fragments (<2 mm). Abrupt contact into:	Organic alluvium
	3.26	3.32	Stiff very decomposed PEAT with frequent very small (<2 mm) shell fragments. Abrupt contact into:	Peat
	3.32	3.49	Stiff dark olive grey very organic silty CLAY with frequent very small shell fragments (<2 mm). Diffuse contact into:	Organic alluvium
	3.49	3.86	Stiff dark olive grey organic silty CLAY with rare very small (<2mm) shell fragments. Diffuse contact into:	Organic alluvium
	3.86	4.00	Firm dark olive to black very weakly decomposed PEAT with frequent plant remains including bogbean seeds, sedges and roots. Occasional woody material. 3.90 to 4.00 m bsf is present as bagged shoe sample.	Peat

Geophysical Survey & Palaeolandscape Assessment

- Assessment of marine geophysical survey data to reconstruct submerged landscape features
  - River channels and lakes
  - Estuaries and coastlines
  - Wetlands
  - Peat and organic sediments
  - Fine-grained deposits
- Mainly based on bathymetry, seismic and sub-bottom profiler (SBP) data
- The marine equivalent of LiDAR on land!
- Fundamental for interpreting and providing landscape context to deposits

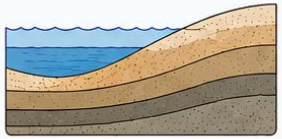


Geotechnical Survey & Geoarchaeological Assessment

- **Vibrocores**
  - Continuous sequences of samples in core liners
  - Shallow (<6m)
- **Boreholes**
  - Variable sampling; often ‘bagged’
  - Deep (up to 60m)
- **Cone Penetration Tests (CPTs)**
  - Density/stiffness of deposits
  - No samples

1. SEDIMENTOLOGY

Environment of deposition and palaeoenvironmental/archaeological potential



- Grain size, sediment type, facies
- Energy conditions
- Transport & deposition processes
- Preservation potential
- Palaeoenvironmental indicators
- Archaeological potential

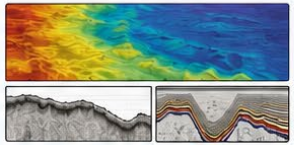
2. STRATIGRAPHY

How do the deposits fit within the existing lithostratigraphic framework?

- Lithostratigraphic units
- Surfaces & boundaries
- Facies relationships
- Sequence & context
- Architectural elements
- Fit within regional framework

3. GEOPHYSICAL ASSESSMENT (OF PALAEOLANDSCAPES)

Map and characterise buried landscapes and subsurface features



- Bathymetry (MBES)
- Side-scan sonar
- Sub-bottom profiling
- Magnetometry
- Seismoacoustics / seismic
- Ground-penetrating radar (in shallow settings)
- Identify buried landforms, channels, features & targets

4. GEOCHRONOLOGY

Age and archaeological potential

- Radiocarbon, OSL, etc.
- Establish timing of deposits
- Constrain phases of activity
- Age-depth modelling
- Links events to chronology
- Assess archaeological potential

5. PALAEOENVIRONMENTAL RECONSTRUCTION

Environment of deposition and archaeological potential

- Microfossils, pollen, geochemistry
- Climate & sea-level indicators
- Habitat & resource availability
- Environmental change over time
- Palaeoenvironmental context
- Archaeological potential

INTEGRATED INTERPRETATION

Depositional, palaeoenvironmental & archaeological potential → Stratigraphic position & landscape setting → Timing of deposition & activity; environmental context

CROSS-CUTTING CONSIDERATIONS

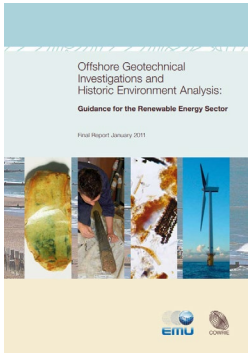
- Taphonomy & site formation processes
- Transgression / regression history
- Human activity indicators
- Data quality & uncertainty
- Preservation & detection potential
- Regional geomorphological context

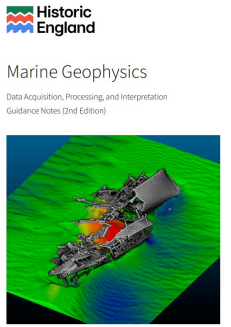
ASSESSMENT OF GEOARCHAEOLOGICAL POTENTIAL

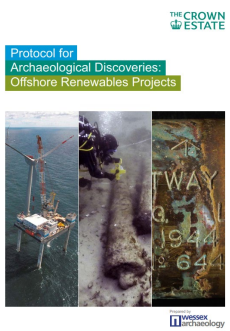
Preservation potential | Likelihood of archaeological remains | Significance of potential resource | Confidence of interpretation = Overall geoarchaeological potential (High / Moderate / Low)

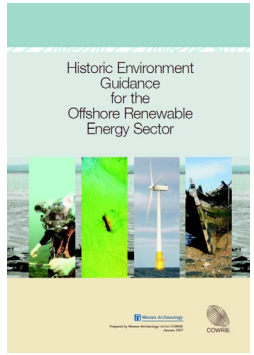
Guidance for marine geoarchaeology

Guidance / Framework	Organisation	Year	Main Purpose	Relevance to Marine Cultural Heritage & Geoarchaeology
Archaeological Written Schemes of Investigation for Offshore Wind Farm Projects	The Crown Estate	2021	Guidance for archaeological survey, investigation and assessment for offshore wind	Establishes requirements and responsibilities for the historic environment, including geoarchaeology
Historic Environment Guidance for the Offshore Renewable Energy Sector	COWRIE / Wessex Archaeology	2007–2011	Guidance for assessing impacts of offshore wind on archaeology	Established best practice for offshore geophysical survey, archaeological assessment, and mitigation
Offshore Geotechnical Investigations and Historic Environment Analysis: Guidance for the Renewable Energy Sector	COWRIE / Wessex Archaeology	2011	Best practice for integrating geotechnical data into archaeology	Key guidance for identifying peat, palaeosols, fluvial deposits, and submerged landscapes in boreholes
Palaeolithic and Mesolithic Archaeology on the Sea-Bed: Marine Aggregate Dredging and the Historic Environment	Wessex Archaeology / BMAPA / English Heritage	2002	Outlines Palaeolithic and Mesolithic archaeological potential of marine aggregate areas	Embedded geoarchaeological approach to marine cultural heritage
Marine Aggregate Industry Protocol for Archaeological Discoveries	BMAPA / Historic England	2005+	Reporting and management of archaeological finds during dredging	Major framework for submerged prehistoric archaeology
Historic England Marine Geophysics Guidance	Historic England	2013+	Guidance for archaeological interpretation of geophysical data	Supports palaeolandscape assessment and site identification
Geoarchaeology: Using Earth Sciences to Understand the Archaeological Record	Historic England	2015	National geoarchaeology framework	Integrates geological and archaeological interpretation
The Assessment and Management of Marine Archaeology in Port and Harbour Development	Historic England / Wessex Archaeology	2016	Good practice for planning and development of ports and harbours	Includes guidance on geoarchaeological assessment



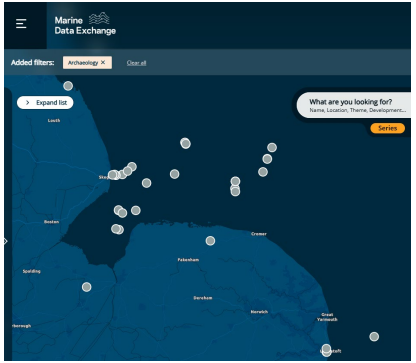


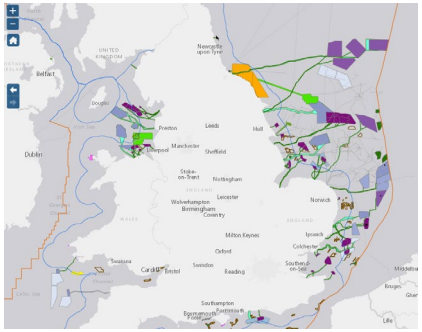


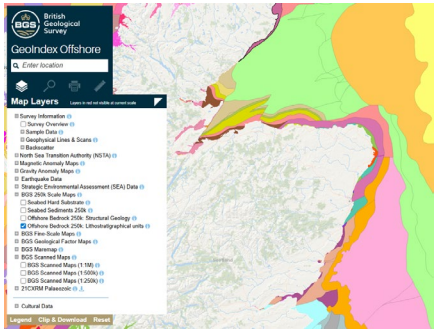


Resources – Digital Data

- **EMODnet**
  - Bathymetry
  - Geology
  - Submerged landscapes
- **Marine Data Exchange**
  - Geotechnical and geophysical datasets
  - Archaeological reports
- **The Crown Estate Open Data Portal**
  - Marine development shapefiles (e.g. aggregates and wind)
- **Archaeology Data Service**
  - Digital data from research projects e.g. (Unpath'd Waters)
- **BGS GeoIndex (offshore)/Text Viewer**
  - Geology
  - Borehole data
  - Offshore Regional reports
- **Unpath'd Waters Data Portal**
  - Marine archaeological finds







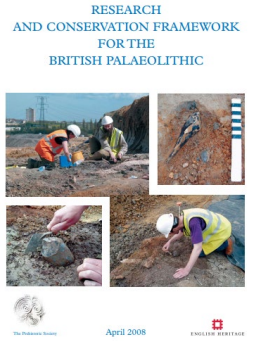
Other Resources

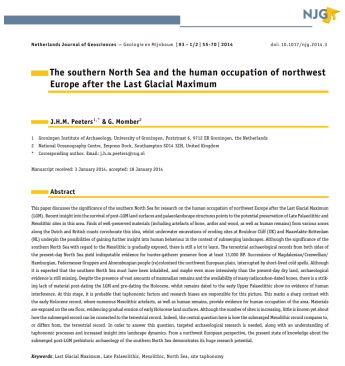
- **Regional Environmental Characterisations (MALSF)**
  - Outer Bristol Channel
  - Eastern English Channel
  - South Coast
  - Outer Thames
  - East Coast
  - Humber

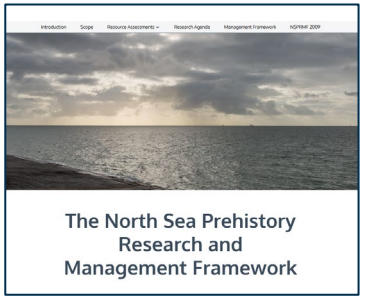
- **Academic publications**

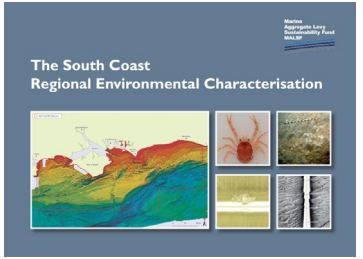
- **Research Frameworks (and Resource Assessments)**
  - North Sea Prehistory Research and Management Framework
  - Maritime Archaeological Research Agenda for England
  - Research and Conservation Framework for the British Palaeolithic
  - National Mesolithic Research Framework

- **Research projects**









Research Projects

Project	Dates	Lead / Partners	Focus
North Sea Palaeolandscapes Project (NSPP)	2003–2007	University of Birmingham (V. Gaffney et al.)	Groundbreaking mapping of Doggerland using 3D seismic data (~23,000 km²) (Archaeology Data Service)
West Coast Palaeolandscapes Project (WCPP)	2010-2011	University of Birmingham/Dyfed Archaeological Trust/RCAHMW	Reconstruction of prehistoric landscapes of the Bristol Channel and Liverpool Bay using seismic data (West Coast Palaeolandscape Project)
Submerged Prehistoric Archaeology and Landscapes of the Continental Shelf (SplashCOS)	2009-2013	European international partners (European Commission funded)	Study of prehistoric landscapes and archaeological remains on the continental shelf around Europe (splashcos.org)
BRITICE-CHRONO	2012–2018	NERC consortium (UK Universities)	Ice-sheet and sea-level modelling underpinning palaeolandscape reconstructions (Historic England)
Europe's Lost Frontiers	2015–2020	University of Bradford + international partners (ERC-funded)	Advanced mapping, coring, and modelling of Doggerland landscapes and human occupation (NERC Open Research Archive)
Taken at the Flood	2020-2025	University of Bradford + industry partners (UK AHRC funded)	Discovering submerged prehistoric archaeology of the Southern North Sea (Taken at the Flood)
SUBNORDICA	Ongoing	Submerged Landscapes Research Centre (Bradford) + international partners (ERC-funded)	AI-led identification of potential prehistoric settlement zones across North Sea seabed (University of Bradford)

Challenges

- **Skills shortage – too few marine geoarchaeologists!**
  - How do we encourage people into marine geoarchaeology?
- **Sample retention – too many samples lost to geotechnical testing!**
  - How do we fix it?
- **Approaches to archaeological mitigation**
  - What are we aiming for?
- **Do we need a guidance document for marine geoarchaeology?**

Questions or thoughts!