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# Chapter 11 Coastal assemblage GCR sites

## Introduction

V.J. May

There are several lengths of the British coast in which, in addition to outstanding specific features such as well-developed saltmarshes or gravel beaches, the total assemblage of individual features is also outstanding. There are seven sections of coast in Britain selected for the GCR that each contain a wide diversity of individual coastal forms that together form an integrated coastal system or 'coastal assemblage' (see (Figure 1.2) for locations and (Table 11.1), below, for an outline of the principal features). The sites are Morrich More in the Dornoch Firth, Ross and Cromarty, and Culbin in the Moray Firth in Scotland; Holy Island, Northumberland, the North Norfolk Coast, and The Dorset Coast in England; and Carmarthen Bay and Newborough Warren and Morfa Dinlle at the western end of the Menai Strait in Wales. The origins and dynamics of each site have been the subject of considerable debate. Each of the sites falls within a different part of the British coast and is affected by different tidal and wave conditions, sediment supply and sea-level histories. Carmarthen Bay is the only member of this group of sites that is predominantly macrotidal and faces the high-energy Atlantic wave environment; there are few other sites on the European coast that combine these features with a distinctive record of sea-level change. In contrast, the north Norfolk coast is dominated by large depositional structures mainly in sand and shingle but also sheltering important saltmarshes. The links between the longshore transport regime and the development of the structures has been a focus of debate. Both Carmarthen Bay and the north Norfolk coast include a wide range of predominantly depositional features in which cliff erosion plays a limited role in the sediment budget, and reworking of the existing beaches and shallow-water sediments is more important. Both lie in situations where glaciation has played a role in the development of the coast, either in providing sources of sediments or in producing a cliffed coastline within which the sediments have been deposited and reworked.

**(Table 11.1) Main geomorphological features of the 'Coastal Assemblage' GCR sites.**

Site	Main geomorphological features	Tidal range (m)
Culbin	Extensive dune system with dunes up to 30m high; parabolic dunes; emerged gravel strandplain and spits; sandy spits; gravel spits; extensive intertidal sandflats and saltmarshes; westerly shift.	3.6
Morrich More	Emerged sandy coastal strandplain with interdigitated saltmarsh and sandy beaches on either flank; offshore sandy islands and spit; large parabolic dune system; 1 km width intertidal sandflats in Dornoch Firth.	3.4
Carmarthen Bay	Major dunes; sand-spits and barrier beaches; hard-rock and easily eroded cliffs; rias; emerged beaches; extensive intertidal sandflats; and saltmarshes.	8.0
Newborough Warren and Morfa Dinlle	Major dunes (linear and parabolic); Holocene dunes; gravel spits; hard-rock and easily eroded cliffs; extensive intertidal sandflats; estuary; saltmarshes.	4.2

Holy Island	Barrier beaches; spits; emerged beach; longshore and offshore sediment sources (Huddart and Glasser, 2002) Scolt Head Island, a major barrier island; Blakeney Point, a large shingle spit; intertidal flats; beaches; dunes; saltmarshes; cliffs. One of the few areas on the coastline of England and Wales where saltmarsh morphology, including salt pans, has been examined in detail. Differential erosion to a longitudinal coastline; includes such classic	4.1
North Norfolk Coast		
The Dorset Coast: Peveril Point to Furry Cliff	landforms as Lulworth Cove. Hard-rock and soft-rock cliffs; platforms; landslides; pocket beaches; chines; submerged rock barriers.	1.7 (east) to 2.0 (west)

In contrast, the coast of south-eastern Dorset is cliffed and affected by sea-level change, but one where coastal alignment and forms owe much to geological structure and lithology. Erosion has produced an unrivalled variety of cliffs, bays and beaches. Beaches are formed mainly in flint and chert but, even though the chalk cliffs are undergoing erosion, many of the beaches are not supplied with significant quantities from such sources today. Changes in sea level and in the position of the coastline have left a legacy of hanging and deeply incised valleys, in contrast to Carmarthen Bay where sediment-rich, drowned estuaries and rias feature strongly.

The origins of the Purbeck coast are not well understood, even though parts have been very well described (e.g. Brunsden and Goudie, 1981), especially the geology (Damon, 1884; Strahan, 1898; Arkell, 1947; House, 1993). The sole evidence on this coast of higher sea levels is at Portland Bill, and although the coast east of St Alban's Head may preserve relict features, there is no other direct evidence of higher sea levels here. The effects of differential erosion are well known here. Unlike the other sites, this coast has increasingly been investigated underwater and so the nature of rocky seabed geomorphology can be used to further the interpretation of the features.

Although individual features such as Lulworth Cove and Stair Hole, Dorset, or Scolt Head Island, Norfolk, are outstanding in their own right, their importance is significantly increased by their association with other features of the adjacent coast. Such localities could be included within previous chapters of the present volume, but despite their individual importance, these features are best described within the wider regional context and in association with each other. Three of the sites (Carmarthen Bay, North Norfolk Coast and Dorset Coast) are highly segmented in terms of their morpho-sedimentology, with between 31 and 35 segments each, and averaging 1.7 km in length, based on the form and dynamics of the shoreline (Table 11.2). The coast of Caernarfon Bay includes seven of the CORINE categories (see p. 21, Chapter 1), a smaller number of segments and a similar mean segment length to Carmarthen Bay. This reflects the higher proportion of long sandy beaches. This variety reflects the impact of changing relative sea levels, the resistance of materials, and large-scale deposition.

Large-scale deposition is also a strong theme at Culbin, Morrich More and Holy Island where plentiful sediment has been available for beach building during much of the Holocene Epoch, aided by a falling relative sea level. All three sites combine internationally important features within complexes of gravel features, sand beaches, spits, dunes and saltmarshes. At Culbin, in the Moray Firth, a large gravel strandplain composed of gravel ridges and spits has become elevated over the Holocene Epoch and subsequently buried by large quantities of wind-blown sand. Much of the present-day coast is dominated by sandy beaches and spits, which move westwards, some of the source sand eroded from sand dunes that have been blown eastwards, opposite to the direction of longshore drift. Most of the past and present gravels have migrated west and downdrift at rates of  $15 \text{ m a}^{-1}$  to form an impressive spit complex composed of largely unvegetated recurved ridges that now enclose extensive areas of sandy saltmarshes behind. In contrast to the longshore dominated system at Culbin, the Morrich More in the Dornoch Firth is essentially an emerged sandy strandplain composed entirely of a staircase of dune-capped sandy beach ridges whose orientation matches that of the

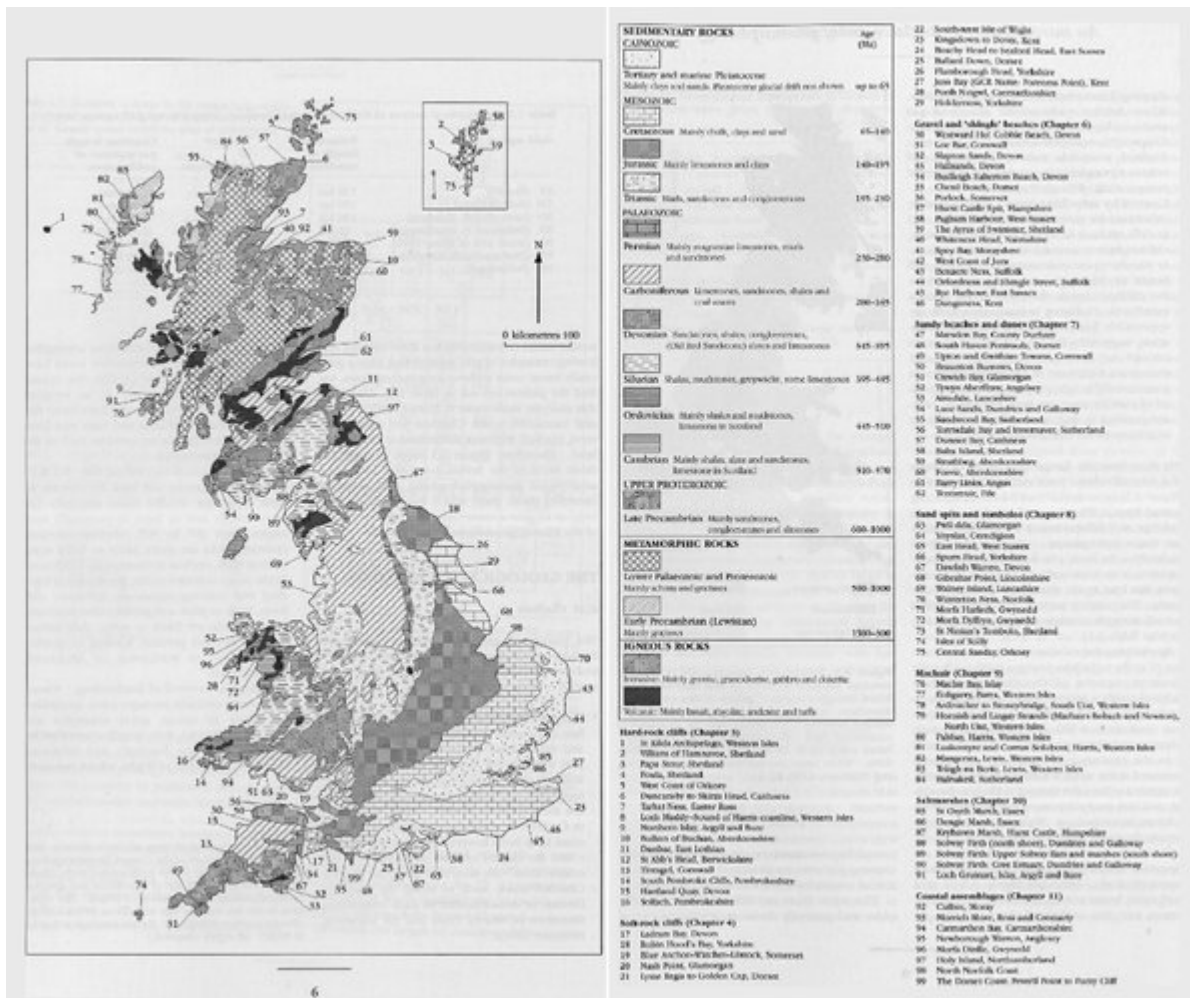
approaching wave crests from the north-east (i.e. swash-aligned). Flanked by inlets on either side, the inter-ridge hollows have allowed tidal access and the development of saltmarsh so that the sandy beach ridges and saltmarsh hollows interdigitate. Since the coast is emerging, there is a close age association between the beaches and the saltmarsh with the youngest saltmarshes occurring towards the flanking inlets and the outer coast.

**(Table 11.2) CORINE categories, data for the Carmarthen Bay, North Norfolk Coast, Purbeck (Dorset Coast) and Newborough Warren/Morfa Dinlle GCR sites; measurements are in km.**

	<b>CORINE categories</b>	<b>Carmarthen Bay</b>	<b>North Norfolk</b>	<b>Purbeck</b>	<b>Newborough Warren and Morfa Dinlle</b>
(A)	Hard-rock cliffs (with fringing beaches)	10	0	7	4
(B)	Soft rock cliffs (with fringing beaches)	1(1)	2(1)	21(4)	1
(C)	Pocket beaches	1	0	3	0
(D)	Coarse elastic beaches	2	3	0	1
(E)	Sandy beaches	9	13	0	5
(G)	Foreshores: fine sediments	4	11	11	1
(H)	Estuary	2	1	1	1
(J)	Port/harbour zone	3	0	0	0
(L)	Embankment	0	1	1	1
(I)	Mixed beaches	0	2	2	0
	Mean segment length (km)	2.25	1.47	1.42	2.30
	Total segments	32	35	31	14

The south-western end of the Menai Strait brings together two sites of international importance in their own right, Newborough Warren and Morfa Dinlle. In both sites, the development of dunes plays a role, although this is the dominant interest at Newborough Warren. The spits and gravel ridges of the Abermenai spit and at Morfa Dinlle combine to provide evidence of the Holocene development of the shoreline of a major tidal estuary in which there has been little anthropogenic interference.

The present chapter describes sections of the British coastline that have been least affected by human interference. They show extraordinarily well the ways in which coasts of different geological materials and structures respond to marine and subaerial processes over a wide range of time and spatial scales. The Scottish site descriptions are followed by those for Wales and lastly for England.



(Figure 1.2) Geological map of Great Britain, also showing the locations of the Coastal Geomorphology GCR Sites. The map shows sedimentary rocks classified according to their age of deposition and igneous rocks according to their mode of origin. The numbers in the key indicate age in millions of years (Ma). (Permit number IPR/26-45C British Geological Survey. (NERC. All rights reserved.)

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Moerich More	Emerged sandy coastal strandplain with interdigitated saltmarsh and sandy beaches on either flank; offshore sandy islands and spit; large parabolic dune system; 1 km width intertidal sandflats in Dornoch Firth.	5.4
Carmarthen Bay	Major dunes; sand-spits and barrier beaches; hard-rock and easily eroded cliffs; ria; emerged beaches; extensive intertidal sandflats; and saltmarshes.	8.0
Newborough Warren and Moeta Dindle	Major dunes (linear and parabolic); Holocene dunes; gravel spits; hard-rock and easily eroded cliffs; extensive intertidal sandflats; estuary; saltmarshes.	4.2
Holy Island	Barrier beaches; spits; emerged beach; longshore and offshore sediment sources (Huddart and Glasser, 2002)	4.1
North Norfolk Coast	Scull Head Island, a major barrier island; Blakeney Point, a large shingle spit; intertidal flats, beaches; dunes; saltmarshes; cliffs. One of the few areas on the coastline of England and Wales where saltmarsh morphology, including saltpans, has been examined in detail.	6.5 (west) to 4.7 (east)
The Dorset Coast: Peveril Point to Furry Cliff	Differential erosion to a longitudinal coastline; includes such classic landforms as Lubworth Cove. Hard-rock and soft-rock cliffs; platforms; landslides; pocket beaches; chutes; submerged rock barriers.	1.7 (east) to 2.0 (west)

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