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# Coastal geomorphology of Great Britain

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In 1988, Dr W.A. Wimbledon invited Professor V.J. May to prepare a text for publication as a GCR Series volume, detailing the English and Welsh sites, and this was completed for the newly formed JNCC in 1992. Thanks are especially due to Dr Wimbledon for guidance and encouragement. However, in reviewing its plans for the publication of the GCR Series, a decision was made to produce a single volume covering the coastal geomorphology of the whole of Britain, rather than just England and Wales. Therefore Dr J.D. Hansom was invited by JNCC to prepare text for publication for the Scottish sites, and Professor V.J. May updated the already drafted reports for England and Wales.

Within this volume, the descriptions and interpretations of individual sites lean heavily on the observations and research of many individuals. Although published source material is referenced, the authors of the volume have also contributed their own personal knowledge of many of the sites. This text is thus a synthesis of understanding where the credits reach far wider than the names attributed to each part of the book. Grateful acknowledgement is therefore accorded to Professor W Ritchie, Dr L. Pierce, Dr S. Gemmell, Dr A. Dawson, Dr S. Angus, Dr G. Lees and Dr F. Mactaggart.

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## **Access to the countryside**

This volume is not intended for use as a field guide. The description or mention of any site should not be taken as an indication that access to a site is open. Most sites described are in private ownership, and their inclusion herein is solely for the purpose of justifying their conservation. Their description or appearance on a map in this work should not be construed as an invitation to visit. Prior consent for visits should always be obtained from the landowner and/or occupier.

Information on conservation matters, including site ownership, relating to Sites of Special Scientific Interest (SSSIs) or National Nature Reserves (NNRs) in particular counties or districts may be obtained from the relevant country conservation agency headquarters listed below:

Countryside Council for Wales, Maes-y-Ffynnon, Penrhosgarnedd, Bangor, Gwynedd LL57 2DN.

English Nature, Northminster House, Peterborough PE1 1UA.

Scottish Natural Heritage, 12 Hope Terrace, Edinburgh EH9 2AS.



## Preface

Few countries can boast a coastline as geomorphologically diverse as that of Great Britain. From the island and fiord coastline of north-west Scotland to the ephemeral sand and mud coastlines of eastern England, it is a landscape of contrasts. The spectacular sheer cliffs of St Kilda have hardly changed in centuries, but in areas such as Holderness in eastern England, erosion has been so rapid that land and homes have been lost to the sea at dramatic rates. Areas of extensive coastal urbanization are in stark contrast to other coasts that are surprisingly untouched by development. There are classic 'textbook' examples of typical coastal geomorphological features cited the world over, such as Scolt Head Island, Lulworth Cove, Chesil Beach and St Ninian's Tombolo, and yet others such as the machair of the west coast of Scotland that are unique to the British Isles. These features can be visually spectacular, and many have earned international renown scientifically and aesthetically.

The broad outline of the coastline owes much to the variety of rocks and large-scale geological structures (such as the Great Glen Fault in Scotland), which have different levels of resistance to erosion; the pattern of the coastline of northern and western Britain can be largely attributed to the differential resistance to erosion of the rocks over many millennia and several glaciations. Ice-Age glaciation and fluvial and marine processes have superimposed drainage networks and carved an intricate pattern of coastal landforms including headlands, bays and estuaries. Glaciers have also deposited vast stores of sediment offshore, much of which has been brought ashore subsequently by marine transgression in the Holocene Epoch to form large, depositional, coastal landforms.

Relative to land, sea levels have varied so much during the last 20 000 years that coastal landforms include surfaces now many metres above the sea, as well as submerged features formed when sea level was relatively low compared to present-day. If present-day sea level continues to rise, many of the beach sites will be affected further by erosion, part of the continuing evolution of the British coastline. Many of the sites in the southern part of Britain provide excellent opportunities for the monitoring and modelling of the effects of sea-level change because they have lengthy records of shoreline change and beach profiles that can serve as baselines. They may help us understand future coastal changes associated with sea-level rise (or its absence) resulting from climate change.

Whereas small-scale features may reach equilibrium within a single tidal cycle, beaches and saltmarshes may take several centuries to reach equilibrium and the larger-scale configuration of the coastline may require several thousands of years to adjust to the Holocene rise in sea level and isostatic rebound.

In many locations, the coastline also owes its present characteristics to such human activities as land 'reclamation' (land-claim, an activity that has been going on since Roman times), gravel and sand extraction, flood defences, protection against erosion, and harbour construction. The rarity of saltmarsh along much of the British coast reflects the role of catchment management affecting fine-grained sediment transport and the effects of land-claim.

The coast has, as a result, been the focus of considerable political attention, arising from major engineering programmes including the Thames Barrage (the development of which was stimulated by the 1953 floods), and the construction and servicing of the North Sea oil and gas resources. The coast has also been the centre of debate about the quality of the environment, especially beach quality. The coast is also important for recreation and as the location of many of Britain's resorts. The 19th century growth of the seaside resorts meant that many areas of previously rural coastal land were developed. Since then, protection measures have had significant impacts on coastal processes. In many cases, a policy of nonintervention might prove more efficient in the longer term, not least where the beaches themselves provide a natural form of protection that can continue to transgress with a rising sea level. Such a policy is geomorphologically sound, but may be politically insensitive where communities live close to sea level. Nevertheless it may prove the sounder economic policy if vast sums are not to be devoted to sea defences that will need to be rebuilt regularly.

Many of Britain's coastal features are of worldwide significance, reflecting not only their intrinsic nature, but also the substantial record of scholarship and research devoted to their description and understanding. There is still much more to learn; the sites continue to play a part in future research. The sites selected for the Geological Conservation Review represent not only this international reputation, but also provide a nationwide framework of landforms and processes

within which research and education can continue to develop. They have been chosen to represent the rich variety of coastal landforms and to provide a network of sites that reflect the different results of rock-type, structure, sediments, wave and tidal conditions, and climate. In an environment as dynamic as the coast, it has been taken as axiomatic that some sites should be included despite significant levels of human intervention in natural processes. This should help to ensure that sites that are of international importance can be protected and that the influence of human activities can be integrated with studies of the natural processes.

Britain's coast is also the home of many rare species and the location of fragile habitats. Much of the coast is noted for nesting and roosting birds; for example, Little Terns on shingle beaches and Guillemots on hard-rock cliffs. Therefore, the stability or dynamism of the geomorphological features and processes is intrinsically linked to the future of coastal wildlife and habitat sites. Although 'biological' conservation sites are not described in this volume *per se*, key sites are also important as wildlife and habitat Sites of Special Scientific Interest; internationally important sites are protected through further designations — all, however, depend ultimately on the relationships between the geomorphological and oceanographic processes affecting their ecosystems.

This volume deals with the state of knowledge of the sites available at the time of writing, in 1995–2002, and must be seen in this context. Geomorphology, like any other science, is an ever-developing pursuit with new discoveries being made, and existing models are subject to continual testing and modification as new data come to light. Increased or hitherto unrecognized significance may be seen in new sites, and it is possible that additional sites worthy of conservation will be identified in future years. Effects of coastal processes and development means that the GCR site list must, like the sites themselves, be dynamic.

This volume is not a field guide to the sites, nor does it cover the practical problems of their future conservation. Its remit is to put on record the scientific justification for conserving the sites. It will be invaluable as an essential reference book and, it is hoped, will provide a stimulus for further scientific research. The conservation value of the sites is mostly based on a specialist understanding of the features present and is, therefore, of a technical nature. The account of each site in this book ends, however, with a brief summary of the geomorphological interest, framed in less technical language, in order to help the non-specialist. The first chapter of the volume, used in conjunction with the glossary, is also aimed at a less specialized audience.

The educational significance of the coast, and the interest stimulated by appropriate information, is difficult to assess, but the number of people whose first interest in geology, geomorphology and environmental processes was awakened on a visit to the coast is incalculable.

There is still much more to learn and the sites described in this volume are as important today as they have ever been in increasing our knowledge and understanding of the geological history of Britain. This account clearly demonstrates the value of these sites for research, and their important place in Britain's scientific and natural heritage. This, after all, is the main objective of the GCR Series of publications.

V.J. May, J.D. Hansom, K.M. Clayton and E.C.E Bird, January 2003