Quaternary of South-West England

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Chapman & Hall

The Geological Conservation Review Series

The comparatively small land area of Great Britain contains an unrivalled sequence of rocks, mineral and fossil deposits, and a variety of landforms which encompass much of the Earth's long history. Well-documented ancient volcanic episodes, famous fossil sites, and sedimentary rock sections, used internationally as comparative standards, have given these islands an importance out of all proportion to their size. The long sequences of strata and their organic and inorganic contents have been studied by generations of leading geologists, giving Britain a unique status in the development of the science. Many of the divisions of geological time used throughout the world are named after British sites or areas; for instance the Cambrian, Ordovician and Devonian systems, the Ludlow Series and the Kimmeridgian and Portlandian stages.

The Geological Conservation Review (GCR) was initiated by the Nature Conservancy Council in 1977 to assess and document the most scientifically-important parts of this rich heritage. The GCR reviews the current state of knowledge of key earth-science sites in Britain and provides a firm basis upon which site conservation can be founded in years to come. Each GCR volume describes and assesses networks of sites of national or international importance in the context of a portion of the geological column, or a geological, palaeontological, or mineralogical topic. The full series of 42 volumes will be published by the year 2000.

Within each individual volume, every GCR locality is described in detail in a self-contained account, consisting of highlights (a précis of the special interest of the site), an introduction (with a concise history of previous work), a description, an interpretation (assessing the fundamentals of the site's scientific interest and importance), and a conclusion (written in simpler terms for the non-specialist). Each site report is a justification of a particular scientific interest at a locality, of its importance in a British or international setting, and ultimately of its worthiness for conservation.

The aim of the Geological Conservation Review series is to provide a public record of the features of interest in sites being considered for notification as Sites of Special Scientific Interest (SSSIs). It is written to the highest scientific standards but in such a way that the assessment and conservation value of the sites is clear. It is a public statement of the value placed upon our geological and geomorphological heritage by the earth-science community that has participated in its production, and it will be used by the Joint Nature Conservation Committee, the Countryside Council for Wales, English Nature and Scottish Natural Heritage in carrying out their conservation functions. The three country agencies are also active in helping to establish sites of local and regional importance. Regionally Important Geological/Geomorphological Sites (RIGS) augment the SSSI coverage, with local groups identifying and conserving sites which have educational, historical, research or aesthetic value, enhancing the wider earth-science conservation perspective.

All the sites in this volume have been proposed for notification as SSSIs; the final decision to notify or re-notify sites lies with the governing councils of the appropriate country conservation agency. Information about the GCR publication programme may be obtained from:

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work for compiling the volume, involving field visits and site descriptions, was begun by Stewart Campbell. The writing of this volume was initiated by the Nature Conservancy Council in 1990, and has been seen to completion by the Joint Nature Conservation Committee on behalf of the three country agencies, English Nature, Scottish Natural Heritage and the Countryside Council for Wales. Each site account bears the name of its author(s). Draft text was produced by the named contributors from 1990 to 1994. All the draft site descriptions, introductory passages and figures were edited and unified into the designated format of this publication series by Stewart Campbell between 1994 and 1997. Within this volume, all published source material is duly referenced. In addition, the authors of the volume have contributed their own personal knowledge of sites, and numerous extra notes, concepts and descriptions have been incorporated from unpublished thoughts and discussions: several sites are described in detail for the first time here.

The selection of the 63 GCR sites described in this volume involved the assessment of several hundred potential localities. In addition to the named contributors, many members of the earth-science community assisted with information or advice during site selection and documentation. Without their assistance, the volume could not have been produced. The help of the following colleagues is therefore gratefully acknowledged: J. Alan, A. Bolt, D.Q. Bowen, D. Brunsden, C. Caseldine, J.A. Catt, R.A. Cullingford, D.C. Davies, K.H. Davies, D.D. Gilbertson, N. Glasser, A.B. Hawkins, A. Heyworth, S.A.V. Hill, C.E. Hughes, H.C.L. James, C. Kidson, M. Macklin, D. Maguire, D. Mottershead, N. Perkins, H. Prudden, J. Rooke, J. Rose, P. Sims, A. Straw, A.J. Sutcliffe, N. Thew, R.S. Waters, R.C. Whatley and R. Wolton.

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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 or that a right of way exists. 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 in no way 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, Plas Penrhos, Ffordd Penrhos, Bangor, Gwynedd LL57 2LQ.

English Nature, Northminster House, Peterborough PEI 1UA.

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

Preface

Structure of the volume and terminology used

This book contains scientific descriptions of 63 localities (Figure A) of at least national importance for Quaternary geology, geomorphology and environmental change in South-West England. These sites were selected by the Geological Conservation Review and are accordingly designated 'GCR' sites. Chapter 1 provides an introduction to the Quaternary. Chapter 2 synthesizes the geomorphological development and Quaternary history of the region, and outlines the principles involved in site selection.

The individual GCR site descriptions form the core of the book. In the following chapters, sites are arranged and described in broad geographic areas and by research topic. This is necessitated by the widely disparate nature of the field evidence in South-West England: sites demonstrating the full range of Quaternary and geomorphological features are not evenly and conveniently dispersed throughout the region, and some areas have significant gaps. Neither do the individual chapters contain sites that necessarily equate with particular site selection networks. Rather, the chosen chapter headings provide the least repetitive means of describing the sites and background material. Where possible, a chronological approach, from oldest to youngest, has been used to describe sites within a given chapter. Again, this approach is not always possible, and a group of sites may show variations on landform or stratigraphic evidence broadly within one major time interval or chronostratigraphic stage; inevitably there are many overlaps.

Each chapter introduction provides an overview of the region or topic, highlighting the particular aspects of Quaternary or geomorphological history which are of special significance. The individual site reports each contain a synthesis of currently available documentation and interpretations of the site evidence. A key part of each site account is the 'Interpretation' section, which explains the site's importance in a regional, national or international context, and justifies its conservation. Where sites were chosen as part of a closely related network, cross-reference is made to the related sites to provide a fuller understanding of their respective attributes and the justification for their selection. Where sites are of particular historical significance, the history of study at the site is presented in detail.

There is currently no universally agreed system of terminology for the subdivision of Quaternary deposits in Britain. Mitchell *et al.* (1973b) proposed a correlation scheme based on standard stages. Since that date, however, not only has there been a great increase in knowledge of the Quaternary succession, so that the 1973 system is now incomplete, but also certain of the stage names proposed at the time have been questioned as to their suitability or even the existence of the sediments to which they refer.

(Figure A) Location of Geological Conservation Review (GCR) sites described in this volume.

(Figure B) A stratigraphical correlation of the Geological Conservation Review sites described in this volume. Sites appear more than once where they have multiple interests, or interests of different ages. Many of the ascriptions are highly provisional, and reference should be made to the individual site reports in this volume for a fuller discussion of the possible ages of the site evidence. Particular uncertainties are denoted by question marks.

The most recent attempt to correlate Quaternary deposits across Britain (Bowen, in prep.) has been based on lithostratigraphy and a time-frame founded on oxygen isotope stages. This scheme has been applied to South-West England (Campbell *et al.,* in prep.) and, wherever possible in this volume, site evidence is referred to the oxygen isotope framework. The basis of such a chronology is the oxygen isotope signal recognized in deep-sea sediments. This signal has been shown to be a function of the Earth's orbital parameters (Hays *et al.,* 1976), and astronomical data have been used to 'tune' the geological timescale (cf. Imbrie *et al.,* 1984; Prell *et al.,* 1986; Ruddiman *et al.,* 1986, 1989; Martinson *et al.,* 1987). For the period back to about 620 ka, the timescale is that developed by Imbrie *et al.* (1984), which has been substantiated by later work (Prell *et al.,* 1986; Shackleton *et al.,* 1990). For the earlier part of the Quaternary, the revised

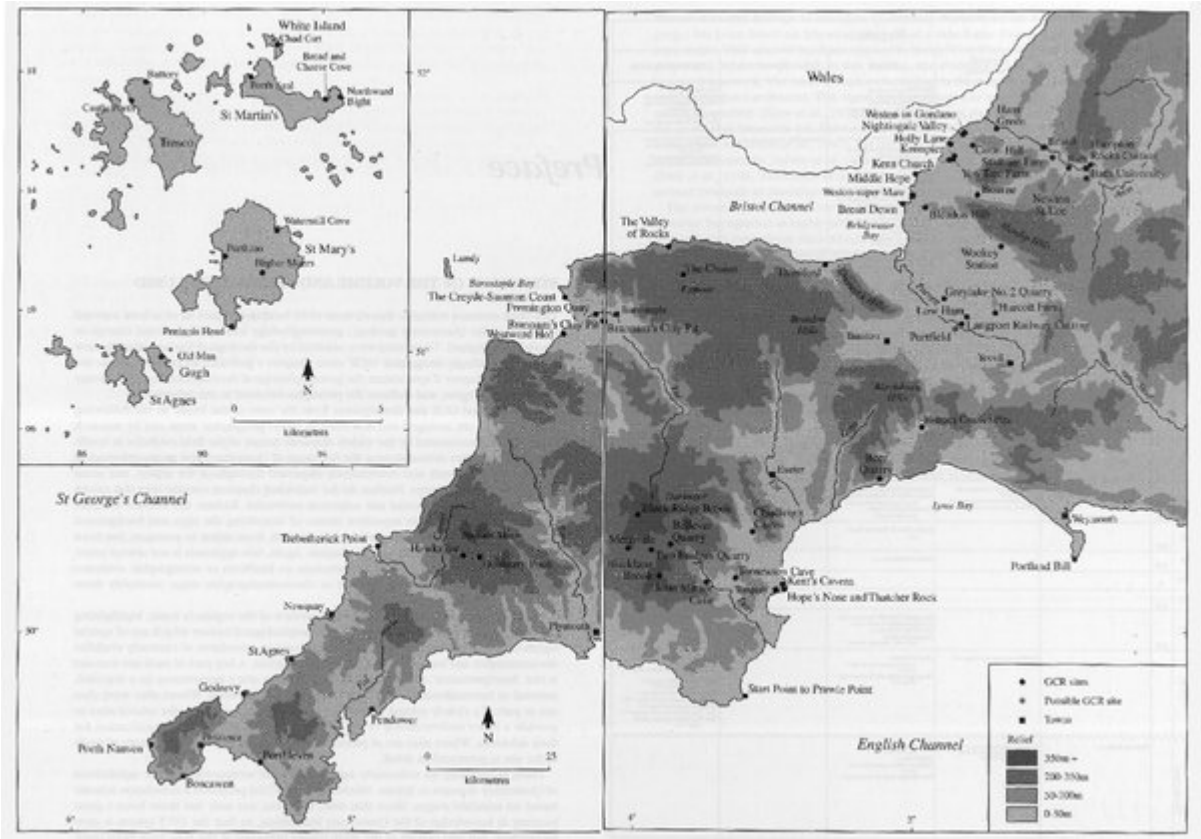
timescale of Shackleton *et al.* (1990) is adopted.

The correlation of the selected GCR sites for South-West England (Figure B), must however be regarded as highly provisional. The fact is that most site evidence remains undated, and even those sites which have yielded 'absolute' and 'relative' dates are often open to widely disparate interpretations. This volume also describes some 'pre-Quaternary' sites which lend an important insight into the long-term evolution of the British landscape: placing their evidence into a precise timescale is even more tenth ous.

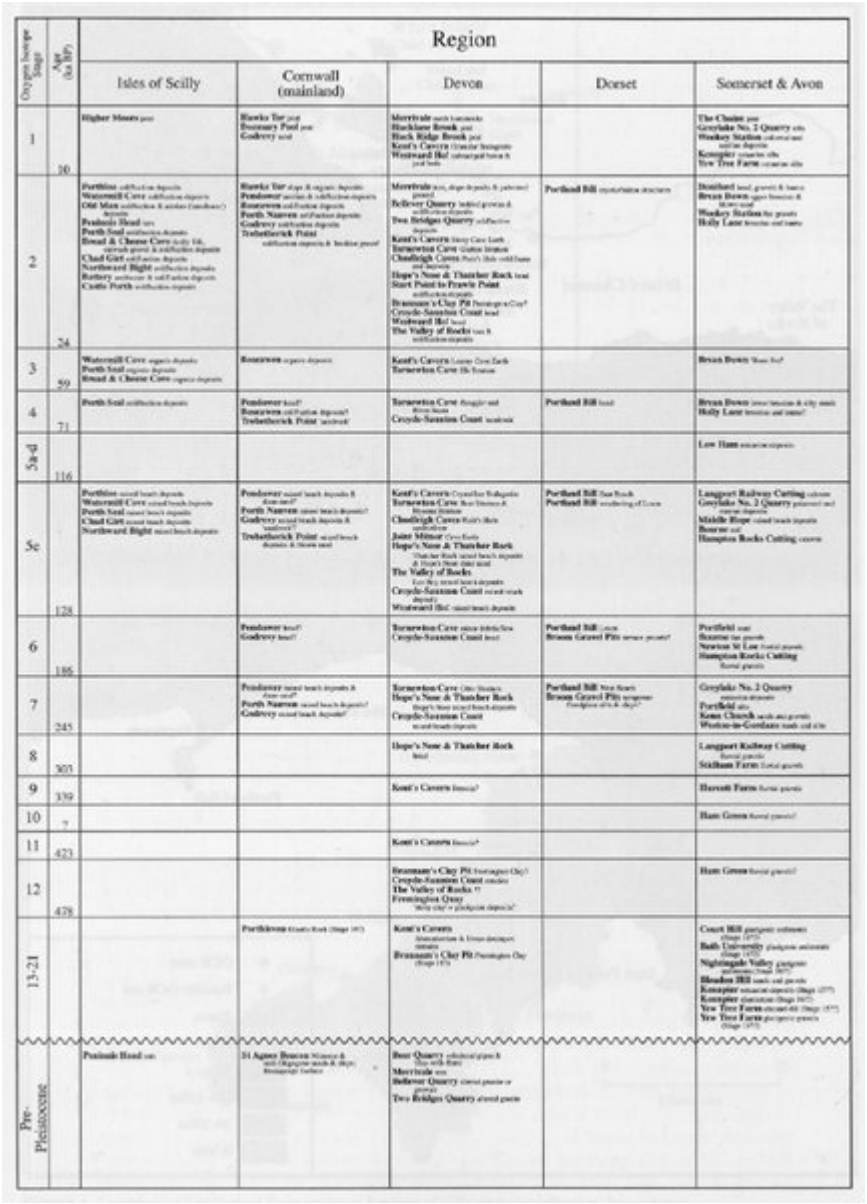
Where radiocarbon 'dates' (age estimates) are cited, they are quoted in radiocarbon years before present (AD 1950), with laboratory reference number and associated standard error if available. It should be noted that the radiocarbon timescale diverges from the calendrical one, and although calibration is available back to 9 ka in detail (cf. Pilcher, 1991) and to 30 ka in outline (Bard *et al.,* 1990), the interpretation of radiocarbon measurements, particularly during parts of the Late Devensian, is additionally complicated (cf. Ammann and Lotter, 1989; Zbinden *et al.,* 1989).

Where possible, modern taxonomic nomenclature has been used and the Geological Society's 'Instruction to Authors' guidelines for taxonomic quotation followed. Nomenclature for marine Mollusca follows Seaward (1982); for freshwater and brackish Mollusca it follows Kerney (1976a); and for land Mollusca it follows Kerney and Cameron (1979).

References



(Figure A) Location of Geological Conservation Review (GCR) sites described in this volume.



(Figure B) A stratigraphical correlation of the Geological Conservation Review sites described in this volume. Sites appear more than once where they have multiple interests, or interests of different ages. Many of the ascriptions are highly provisional, and reference should be made to the individual site reports in this volume for a fuller discussion of the possible ages of the site evidence. Particular uncertainties are denoted by question marks.