Quaternary of Somerset (QA-SOM)

Block Description

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For Quaternary Geology and Geomorphology GCR block descriptions and GCR site lists, visit https://jncc.gov.uk/gcr-blocks-quaternary-geology-and-geomorphology

Introduction

The Quaternary Period is the most recent major subdivision of the geological record, spanning the late Cainozoic Era. Traditionally, it is divided into two intervals of epoch status – the Pleistocene and Holocene. The Holocene Epoch occupies only the last 10 000 years of geological time and is the warm interval or interglacial in which we now live. Consequently, it is often regarded as part of the Pleistocene rather than a separate epoch. In a strict geological sense, the base of the Pleistocene Epoch (and therefore that of the Quaternary Period) is defined in Italy at the type locality of Vrica, where it is dated to about 1.64 Ma (million years ago); it is now well established that the current warm period, the Holocene Epoch, is simply the latest interglacial in a long series of profound climatic fluctuations that have characterized the last 2.4 Ma.

The deep-sea sedimentary record shows that up to 50 'warm' and 'cold' climatic oscillations have occurred within the last 2.4 Ma. Equally, the glacial and interglacial periods cannot be characterized simply as 'cold' or 'warm', respectively; the ice ages were not unbroken in their frigidity since the exceptionally cold phases (stadials) were punctuated by warmer periods (interstadials), in some cases lasting for several thousand years. The fundamental characteristic of the Quaternary Period is therefore one of change through time and space in geomorphological processes, floras, faunas and environmental conditions, all modulated by the changing climate. The record of such changes is preserved in a variety of landforms, sediment sequences and organic remains.

The abrupt onset of the late Cainozoic ice ages is, as yet, unexplained. However, the succession of ice ages (glacials) and interglacials has occurred at known frequencies, and changes in insolation (the receipt of solar radiation at the Earth's surface and throughout its atmosphere) associated with the Earth's orbital rhythms are now established as the principal external driving forces of the Earth's climatic system.

Subdividing the Quaternary Period

The oxygen isotope chemistry of the deep-sea sediment pile now provides the main basis for subdividing the Quaternary swedimentary record, with a number of successive oxygen isotope stages recognized globally. These stages, running counter to normal geological practice, are numbered backwards in time and down through the geological column. Warm periods with correspondingly low volumes of ice are given odd numbers; the present interglacial, the Holocene, is numbered as Stage 1. Times of high ice volume (glacials) are given even numbers; the last main cold phase in Britain, the Late Devensian, being numbered as Stage 2. Stages are also divided into sub-stages, for example, Stage 5 into sub-stages 5a–5e, often reflecting stadial or interstadial events.

The position in the deep-sea sediment cores of a major reversal in the Earth's magnetic field, the Matuyama–Brunhes Reversal at 780 ka, provides a yardstick with which to calibrate the oxygen isotope record. The boundaries of the different isotope stages have also been adjusted and refined with respect to known orbital patterns

British Quaternary environments

In Britain, the area covered by ice varied considerably during different glaciations. During the last (Late Devensian) glaciation, ice extended as far south as the north Midlands, impinging on the north coast of East Anglia and covering most of South Wales. During earlier glaciations ice sheets were more extensive, but probably never reached farther south in south-central and south-east England than the present Thames Valley. In the South-West, there is a longstanding debate over whether pre-Devensian ice masses reached the northern shores of Devon and Cornwall and even the Isles of Scilly.

The major shifts of climate that characterize the Quaternary Period were accompanied by equally profound changes in environmental conditions that left a strong imprint on the landforms, fossils and sediments of Britain. During the cold or glacial stages, substantial areas were subjected to the effects of glacial erosion and deposition and a wide range of landforms and deposits was produced.

As ice sheets melted, vast quantities of meltwater were liberated, giving rise to characteristic suites of landforms and deposits.

Repeated climate change also subjected the flora and fauna of Britain to stress: fundamental changes in the distribution of plants and animals took place. Beyond the margins of the ice sheets and during the cold climatic phases of the Quaternary Period, periglacial conditions prevailed. Such environments were characterized by frost-assisted processes and by a range of frost- and ground ice-generated landforms and deposits. Mass wasting (downslope movement of soil on both large and small scales) and increased wind action were prevalent, also producing a range of characteristic features. In the fossil record, the flora and fauna of these cold periods is, not surprisingly, restricted in diversity and dominated by cold-tolerant species; large areas were dominated by tundra vegetation.

Conversely, the warmer or interglacial periods of the Quaternary are characterized by the absence of glacial, periglacial and glaciofluvial features, and there were times when chemical weathering, soil formation and the accumulation of organic sediments took place. Variations in the quantity and type of pollen grains preserved in organic deposits, such as peats and lake muds, have been used to define systems of pollen zones or pollen biozones. These zones are characterized by particular vegetational assemblages which can be used to chart sequences of vegetational, climatic and environmental change. Traditionally, these have been used as the principal basis for distinguishing between various interglacial phases in the land-based Quaternary record and for the definition of chronostratigraphic stages. Unfortunately, although several distinctive interglacial episodes in the British Pleistocene can be distinguished, very little evolution of the flora actually occurred, thus hindering biostratigraphic correlation. However, interglacial periods can be differentiated broadly on the basis of pollen assemblage zone biostratigraphy, with individual parts of interglacial cycles (sub-stages) being recognized; for example, pre-temperate, early temperate, late temperate and post-temperate sub-stages. Interglacial environments in the British Isles were generally characterized by a climax vegetation of mixed deciduous oak forest. The last time Britain experienced conditions similar to today was about 125 ka, when the interglacial (part of the Ipswichian Stage) lasted about 10 ka.

Unlike the flora, some elements of the Quaternary fauna have evolved. Therefore, certain glacial and interglacial periods can be characterized broadly by distinctive fossil assemblages, particularly those of large mammals. During the last interglacial, for example, creatures such as the hippopotamus, lion and elephant were indigenous to Britain. Likewise, fossils of both terrestrial and marine molluscs and Coleoptera (beetles) can be sensitive indicators of changing climatic conditions by analogy with their present-day environmental tolerances and geographical ranges.

The succession of glacials and interglacials and the growth and decay of ice sheets have been accompanied by equally profound changes in the coastal zone. World sea level has varied in time with the amount of water locked up in the ice sheets, and during glacial stages, world or eustatic sea levels have been lowered. The converse is true during warmer interglacial phases. The level of the land has also varied, sinking under the weight of advancing ice sheets and rising up or rebounding when they melted (isostasy). This complex interplay of changing land and sea levels has left a widespread legacy in Britain, manifested by the many beaches, shore platforms and marine sediments which now lie above the present sea level. Equally, a range of submerged shoreline features, drowned forests and valleys provide important evidence for sea levels which were relatively lower in the past.

Significant changes in the courses of rivers and their channel patterns have also occurred in the Quaternary Period. These are related to changes in discharge, sediment supply and sea level. Some rivers have reworked and built up large quantities of glacially derived sediments along their floodplains. Subsequent down-cutting has sometimes resulted in ‘staircases’ of terraces both in rock and superficial materials. In some valleys, terraces have been traced for considerable distances and been assigned specific names and ages with respect to their contained fossils and stratigraphical position; in many cases they can be ascribed with some certainty to particular interglacial or glacial phases or, more recently, to the oxygen isotope timescale.

GCR site selection

This GCR Block encompasses sites that merit conservation because of their significance to the geomorphological evolution and Quaternary history of Somerset. Sites important for coastal and fluvial geomorphology, in the sense of modern landforms and processes, and large-scale mass-movement features are encompassed by other GCR Blocks.

The landscape of Britain displays a rich diversity of Quaternary features and evidence of environmental change, often with distinct regional associations, related for example to a combination of geology, evolution of river systems, mountain glaciation or patterns of sea-level change.

South-West England, with its unglaciated granite landscapes, periglacial formations and raised beach deposits, is quite distinctive in its characteristics from, say, the Thames Valley, East Anglia or Scotland. Each of these regions offers a distinctive contribution to the overall picture of Quaternary landscapes and environments in Britain. A prime aim of site selection was to reflect this diversity and to select networks of sites representing the major regional variations in landscape evolution and the history of environmental change during the Quaternary Period in Britain; hence the regional approach adopted for site selection.

The themes and issues that form the focus of the Quaternary history and research in a given region primarily reflect the nature of the field evidence available. For example, South-West England, by virtue of its position mostly beyond the margins of the Pleistocene ice sheets, preserves an exceptional record of the long-term evolution of the British landscape. Likewise, Scotland is particularly noted for its assemblage of glacial landforms and 'raised' shorelines formed during the Devensian late-glacial.

Within the general regional framework, the approach adopted was to identify networks of sites that represent the main landscape features, distinctive aspects of Quaternary history and the principal research themes. Such features and themes were recognized at two levels: (a) those relating to the specific characteristics of the area in question (e.g. granite landforms and periglacial features in South-West England); and (b) those relating to national interests or distributions (e.g. pollen biostratigraphy and sea-level changes during the Holocene) for which regional representative sites were required. It should be noted that this categorization relates to the occurrence of the interests and does not imply differences in the importance of sites in the different categories. Thus sites selected for a regionally occurring interest are nevertheless of national importance, for example the tors of Dartmoor or the 'raised' beaches of Devon. Indeed, all the sites selected for the GCR Series are considered to be at least of national importance.

For Somerset, the site networks considered are those representing:

• long-term landscape evolution

• Pleistocene sea-level changes

• periglacial landforms and deposits

• key sequences of deposits for interpreting the distinctive Quaternary history of the region

• Holocene vegetation history