Karst (KAR)

Block Description

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For Geomorphology GCR block descriptions and GCR site lists,
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Introduction

Component of a karst landscape; however, caves are commonly defined as natural cavities large enough to be entered by humans, and some karst landscapes on the softer rocks are drained by fissures too narrow to be described as true caves. Caves have a separate 'Block' in the GCR – see **Caves (CAV)**. Limestone is the only common rock that is highly soluble in natural surface waters, so nearly all karst is formed on limestone. Dolomite may have karstic landforms, generally less well developed than those on limestone. Some karst features are formed by solution of gypsum or salt.

Most cavernous limestones are strong rocks, capable of spanning large underground voids and forming stable cliffs; they are also massive, with widely spaced fractures, some of which are enlarged by solution to form discrete conduits. Chalk is the best known of the weaker, porous limestones, which form a type of karst with few caves large enough to be entered by humans.

Karst lands tend to provide some of the more spectacular natural landscapes, with hills and mountains of white crags and bare rock pavements, pitted by sinkholes and caves. Though limestones are soft (in that they are easily abraded), many are mechanically strong due to their microstructure of interlocking crystals, and all are topographically resistant because much of their erosion is underground; even the weakest limestones, such as chalk, survive as the high ground. For the same reason, limestone karst contains many deep and spectacular gorges; formed in climatic environments of the past, they are preserved because their walls are not eroded by water which has sunk underground.

The preservation of landforms within a karst landscape is most significant beneath the ground surface. A complex cave system is the only erosional environment where each phase of erosion does not remove the features of earlier phases. Capture and diversion of drainage, rejuvenations and steady downcutting create new cave conduits at lower levels, and preserve the products of earlier erosion and deposition that have been abandoned in high-level cave passages – on a scale which can never be achieved in an evolving, eroding and lowering surface topography. Caves are therefore especially significant to geomorphological studies, as their erosional features and accumulated sediments are unique records of past environments in upland regions.

Karst distribution in Britain

The karst of Great Britain is formed on a number of limestones spaced through the stratigraphical column, and also on some units of gypsum and salt. The outcrops of these rocks therefore define the areas of karst landscape, which are widely distributed across England and Wales, but are rather sparse in Scotland. Most of the karst and cave GCR sites are on or in the massive limestone of the Lower Carboniferous Series (**see Dinantian of Northern England & North Wales (DIN-N-E-WL)** for example); this is by far the most important karstic rock in Britain, though the largest area of karst is on the Cretaceous Chalk (see **Cenomanian, Turonian, Senonian, Maastrichtian (CEN-MAA)**), which has very limited cave development.

Karst geomorphology

Both the broadest structure and the topographic texture of a karst terrain are determined by the lithology, strength, porosity and structure of the exposed carbonate succession. In contrast, the main landforms, the karst types and many of the smaller solutional features are all functions of process, and can be identified in karst regions on all types of limestone, as well as on many other types of soluble rock. Features represented in the GCR include dolines, sinkholes, blind /headless or pocket valleys, allogenic or through valleys, karst gorges, dry valleys, limestone pavements and karren as well as representatives of the main karst types (see below).

Limestone pavements and karren

Subaerial and subsoil limestone surfaces are etched by solution into a variety of small features. Dominant are the solution runnels, which are better known by the German term, karren. These are most conspicuous on the bare limestone pavements which were scraped clean by the Pleistocene glaciers in the northern Pennines. Postglacial solution by rainwater enlarging the bedrock fissures has left a pavement of in situ limestone blocks, each locally known as a clint and separated from its neighbours by grikes.

Karst types

Different assemblages of limestone landforms create identifiable karst types which are largely related to the present and past climatic environments in which they have evolved. Within each type, the geological structure of the host soluble rock determines the patterns of underground drainage and also influences the surface topography. The contrasting karst types in the different regions of Britain are functions of both Pleistocene history and local geology.

Glaciokarst is characterized by the inheritance of glacial landforms, and is distinguished by the bare rock surfaces scoured by Pleistocene (or more recent) glaciers. Limestone pavements and scars form on the tops and edges of the outcrops of stronger beds; they are fretted by postglacial karren, and there is minimal development of postglacial soil cover. Deep karst gorges were formed by temporary meltwater rivers, but generally there are few dry valleys. The Yorkshire Dales contain Britain's finest glaciokarst.

Fluviokarst is characterized by dendritic systems of dry valleys. The finest area in Britain is the Peak District, where the valleys were largely excavated under periglacial conditions during the Pleistocene. Karst gorges are developed where the valleys entrenched into steeper slopes, but there are few rock scars; most outcrops of the limestone are covered by soils of solutional residue and aeolian loessic silt.

Polygonal karst is a more mature karstic terrain where dolines have replaced valleys as the main form, and a polygonal network of topographical divides has replaced the dendritic systems of interfluves. This type of karst is poorly represented in Britain, where the Pleistocene climatic fluctuations and glaciations repeatedly interrupted solutional erosion; it is better developed in Mediterranean climatic regimes.

Tropical karsts are the climatic extreme, where the negative landforms of valleys and dolines are replaced by the positive, residual landforms of cones and towers. There is no trace of these karst types in Britain's modern landscape.

Fossil karst or palaeokarst has its solutional landforms buried by later sediments of either clastic or carbonate composition. It includes features as old as the intra-depositional structures within the Carboniferous limestone sequence, and the many fissures filled with Triassic sediments. It also includes the many buried and filled dolines containing Tertiary and Quaternary sediments in the Carboniferous limestones of the Peak District and in the Chalk of southeast England; the latter include the many buried and steep-sided features commonly known as pipes.

Chalk karst is a very distinctive style of topography, developed on the mechanically weak, porous, very permeable and only mildly cavernous chalk; it extends across large outcrops in south-east England. It has extensive dry valley systems, which were enlarged under periglacial conditions, and numerous subsidence dolines formed in weak cover rocks. Soil cover is complete, and there are no scars or crags in the weak rock. Underground drainage is efficient, but there are few caves large enough to be accessible.

Salt karst and gypsum karst are formed on the respective evaporite rocks, both of which are extremely soluble in water. Surface landforms are dominated by solution dolines and broad depressions too shallow to be described as true dolines; these occur on both rock types in

Britain. Gypsum karst may also have large cave systems, but there are only a few small caves in Britain's gypsum.

GCR site selection

The aim of the GCR has been to represent all the important karst types and best examples of karst features. The criteria for selection have therefore been any one of four factors:

1 The finest example of any particular karst landform

2 Unique sites

3 Sites important for teaching and research

4 Important/representative assemblages of landforms features

For the purposes of the GCR sites were selected according to karst regions (following the main limestone areas of Britain), although comparisons between the regions were made to ensure that although karst areas were adequately represented in the GCR, that karst features of similar types were not over-represented.

- Yorkshire Dales
- Northern Pennines
- Peak District
- Mendip Hills
- South Wales
- Rest of Britain.