Geology of the Bath area: Quaternary

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This topic provides a summary of the geology of the Bath area – covered by the British Geological Survey
1:50k geological map sheet 265.
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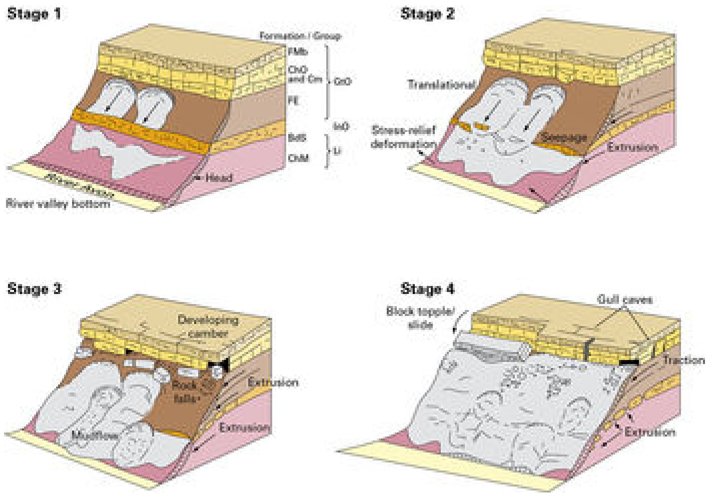
The Quaternary deposits of the district comprise unlithified ('superficial') sedimentary materials laid down during the Pleistocene (2.6 to 0.01 Ma) and Holocene (to present). During the Pleistocene, the British Isles experienced repeated episodes of glaciation, but generally the Bath district is thought to have lain well beyond the maximum ice limits. Consequently, the Quaternary is represented almost entirely by deposits which accumulated through periglacial and fluvial processes.

However, isolated high-level deposits of gravelly sandy clay with flint, quartz, chert and other exotic pebbles occur around Bath, including at up to 175 m OD south-west of Claverton, and as fissure-fills in the Chalfield Oolite (Donovan, 1995)[1]. These are thought to be material deposited either by outwash or by fluvial reworking of remanié till, predating the incision of the Avon valley probably before 0.35 Ma (mid Mid Pleistocene) times (Self, 1995)[2], and indicating that an early Mid Pleistocene ice-sheet may have encroached on the Bath district (Hunt, 1998)[3]. These are termed the Bathampton Down Member (BD) of the Kenn Formation (Campbell et al. in Bowen, 1999)[4].

The modern River Avon is flanked along much of its course by river terrace deposits which represent abandoned floodplains. They are the Bristol Avon Valley Formation, of Mid Pleistocene age, and consist of clay, silt and sand overlying gravel, and three levels can be identified(). However, the unified Avon scheme of Campbell et al. (in Bowen, 1999)[4], with named Bathampton, Stidham and Ham Green members, is not adopted herein as it fails to allow adequately for the influence of the Hanham and Clifton gorges.

The active floodplains of the Avon and its tributaries are underlain by alluvium (), which comprises clay, silt, sand and gravel, in places with beds or lenses of peat. On the east bank of the Avon at Warleigh Wood, narrow tributaries running over limestone bedrock have deposited small spreads of calcareous tufa (). More widely across the district, slopes are commonly mantled with a discontinuous veneer of head deposits (), which represent slope-wash and colluvial materials, deposited both under periglacial conditions in the Pleistocene and under broadly modern climatic conditions in the Holocene. They consist of gravel, sand, silt and clay in variable proportions, reflecting the composition of the geological materials upslope.



Stages of cambering and mass movement of slopes in Middle Jurassic strata in the district. For key to bedrock units, see Geological Description. P785917.

Superficial structures and mass-movement deposits

Along the escarpment and in the valleys of the Cotswolds, slopes have been extensively affected by superficial disturbances dating from Pleistocene times to the present. Within the district there are many areas where strata capping slopes and hills have begun to tilt or move downslope as blocks, due to the deformation of underlying, less competent mudstone/clay beds that have become ductile (Hobbs and Jenkins, 2008)[5]. The process, known as cambering, particularly affects slopes in the Fuller's Earth Formation and Lias Group rocks, which are capped by the Chalfield Oolite Formation or Inferior Oolite Group respectively **(P785917, 6).** Cambered masses that have not become clearly detached from their parent bedrock outcrops (and thus included in landslides) typically have poorly defined lateral extents, and consequently are not distinguished on the geological map. The early stages of cambering lead to the development of large, joint-bounded blocks of limestone, with extensional downslope movement opening the joints and leading to the development of cavities (known as gulls) between blocks (Hobbs and Jenkins, 2008)[5]. Most of the gulls are subsequently partly or wholly filled with rubble, soil or other deposits. Gulls present a significant geological hazard (see Applied geology), and although their overall distribution is poorly known, numerous gulls have been recorded within the district. They may be up to ten metres deep, two metres wide, and several tens of metres long. Where slippage occurs along the interface between the thick beds of the Chalfield Oolite, permitting lower blocks to move, closely spaced open gulls may be present up to 20 metres below ground surface and some distance in from the valley side; gull caves may develop and extend for several hundred metres (Self, 1986[6]; 1995[2]; Self and Boycott, 2000)[7].

Cambering is thought to take place largely under glacial or periglacial conditions (Forster et al., 1985)[8]. Cambered strata are overlain by river terrace deposits at Twerton (Chandler et al., 1976)[9] indicating that at least some movements are ancient. It is not thought that cambering is active here under the present temperate climate, although landslides that are more recent commonly incorporate cambered (e.g. block-toppled) material.

Discrete areas of mass down-slope movement of rock and/or soil are depicted as landslide deposits, and comprise rock falls, mudflows, and either rotational or translational slides which may include detached cambers **(P785917)**. Their formation results from several principal processes, possibly in combination: weathering-induced limestone fragmentation and conversion of mudstone to clay; undercutting or loading of slopes by natural or human actions, and changes in the groundwater regime. An increase in pore water pressure in overconsolidated clay or silt-dominated formations (e.g. Charmouth Mudstone, Bridport Sand, Dyrham, Fuller's Earth and Oxford Clay) and in overlying fine-grained head deposits, can result in reduced shear strength and relatively shallow failure of the hillslope. This commonly occurs by rotational sliding, or by translational sliding (Anson and Hawkins, 2002)[10], particularly within the Fuller's Earth Formation and Lias Group **(see table below)**. The majority of the landslides within the district are of these types, and probably formed during the wetter, periglacial climate of the latest Pleistocene. Many of the older landslides within the district, including those at Bailbrook [773 673], Beacon Hill [751 659], Beechen Cliff [751 641], Twerton [726 644] and North Stoke [700 687], are large rotational failures on the lower slopes, thought to be initiated by the downcutting of the River Avon, perhaps during the later Pleistocene (Kellaway and Taylor, 1968)[11]. Minor movements, usually of mudflow or translational type associated with prolonged saturation, continue to the present day (Anson and Hawkins, 2002)[10] and landslides continue to present a hazard within the district (see Applied geology).

	Cambering	**Landsliding**	**Condition**
Corallian escarpment	Lower Greensand Group and Corallian Group on Oxford Clay Formation mudstone.	Translational slides (rock and soil), debris flows within Oxford Clay Formation mudstone/clay. Mudslide complexes.	Cambering not well distinguished. Landsliding well distinguished but tree-covered.
Cotswold valleys: upper slopes	Great Oolite Group limestone on Fuller's Earth Formation mudstone. Discrete and limited extents, associated with rock fall/slide.	Translational slides (rock and soil), topples, debris flows within Fuller's Earth Formation mudstone/clay. Mudslide complexes.	Cambering and landsliding well distinguished but tree-covered. Erosion by springs.
Cotswold valleys: lower slopes	Inferior Oolite Group limestone on Lias Group sandstone and mudstone. Some draping and thinning downslope.	Debris flows, mudslides, solifluction, head thickening downslope, rotational slumps within Inferior Oolite Group and Lias Group sandstone and mudstone/clay. Occasional rotational slides in Lias Group by river erosion.	Cambering and landsliding poorly distinguished. Erosion by streams and springs. Surface features obscured by farming.

An additional form of ground disturbance that may be prevalent within the district is valley bulging. This occurs when river downcutting results in significant unloading and the upward bulge of parts of the valley floor, typically under periglacial freeze-thaw conditions. It may have taken place in many of the valleys in the district during the Pleistocene, including the Avon valley around Bath, although much of the affected strata may have been removed by Late Pleistocene erosion. Bulging is not thought to be an ongoing process today, but deposits affected may pose a hazard to engineering.

References

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