# Permo-Triassic, its classification and conditions of deposition, Bristol and Gloucester region

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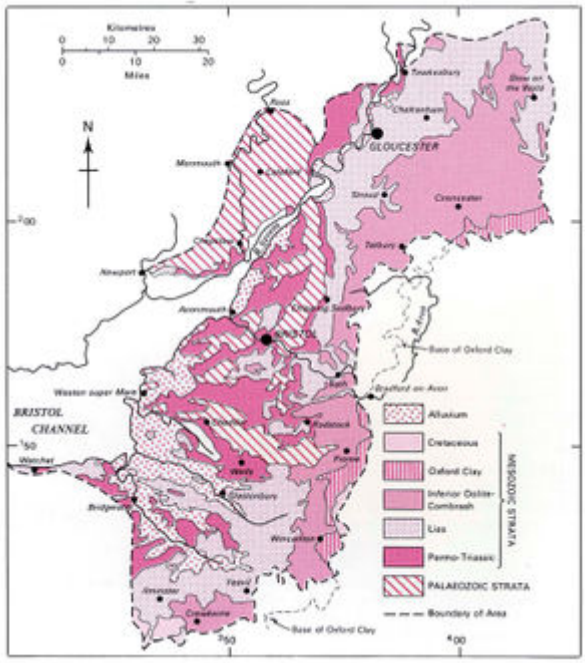
Green, G W. 1992. British regional geology: Bristol and Gloucester region (Third edition). (London: HMSO for the British Geological Survey.)




Sketch map of the geology of the region. (P948956)

| Stages | Groups | Formations | | Members | Former names | |
|---|---|---|---|---|---|---|
| | | South-West | S Midlands | | South-West | S Midlands |
| | Lower Lias (basal part only) | | | | Pre-planorbis beds = Ostrea Beds | |
| | | | | | Watchet Beds *not present* | |
| Rhaetian | Penarth Group | Lilstock Formation | | Langport Member | Langport Beds = White Lias | |
| | | | | Cotham Member | Cotham Beds | |
| | | Westbury Formation | | | Westbury Beds | |
| Norian | Mercia Mudstone Group | Blue Anchor Formation | | | Grey Marl & Tea Green Marl | Tea Green Marl |
| Carnian | | Undifferentiated, mainly red mudstone | | *see text* | Red Marls (Keuper Marl)* | |
| Ladinian | | | | | | |
| Anisian ? Scythian | Sherwood Sandstone Group | Otter Sandstone | Bromsgrove Sandstone | | Upper Sandstones | Keuper Sandstone |
| | | | Wildmoor Sandstone | | | Upper Mottled (Bunter) Sandstone |
| | | Budleigh Salterton Pebble Beds | Kidderminster Formation | | Pebble Beds & Conglomerates | Bunter Pebble Beds |
| [ P E R M I A N ] | | | | | | |

* Some usages included the Grey and Tea Green marls within the Keuper Marl.

Nomenclature of Triassic rocks. (P948995)

Unconformities at Woodhill Bay, near Portishead, Avon. B. Between the Dolomitic Conglomerate (Triassic) and the Lower Old Red Sandstone. (P006749)

Since the early days of geology the term ‘New Red Sandstone’ has been used to describe the dominantly red-bed continental rocks laid down in Britain during the Permian and Triassic periods. The survival of the term reflects the difficulty of subdividing these rocks. In the present region, gently dipping New Red Sandstone strata rest with marked angular unconformity upon a deeply eroded land surface of folded pre-Permian rocks. The outcrop distribution is shown in P948956.

The Permo-Triassic sandstones represent the thickest accumulation of any one sediment type to be deposited anywhere within the region in post-Carboniferous times, and the complete Permo-Triassic sequence is thicker than the sum of all the succeeding sediments in the region. The site of maximum sedimentation was within the Worcester and Central Somerset basins. These were actively subsiding grabens or half-grabens during early Permo-Triassic times, but during the middle and later part of the Triassic period sedimentation spread beyond their earlier confines. The thickest sequence is in the Worcester area, a short distance to the north of the present region, where some 2.5 km of sediments accumulated.

## Classification

P948995 shows the current and former nomenclature of the Triassic rocks of the district. The terms ‘Keuper’ and ‘Bunter’, which had both lithostratigraphical and chronostratigraphical connotations, have been replaced by new lithostratigraphical names (Warrington et al., 1980)[1]. Rhaetic, a term also bearing such connotations, has been abandoned and the name Penarth Group has been substituted. Rhaetian, a standard stage of the Triassic Period is not an equivalent of this. The other standard stages, which are based on ammonite stratigraphy in marine rocks elsewhere in Europe and Asia, are not generally applicable in the region, where fossils are scarce in the largely nonmarine sequence. Spores are potentially the best fossils for erecting a biostratigraphy despite their often poor state of preservation in the oxidised rocks.

Rocks of presumed Permian age occur locally at the base of the New Red Sandstone succession within the region, but the main part of it is Triassic in age. From the base, the Triassic succession is divided into three major divisions; the Sherwood Sandstone, Mercia Mudstone and Penarth groups. The base of the Sherwood Sandstone Group is marked by the first major widespread influx of pebbly debris, and is assumed to be approximately synchronous throughout the area. At outcrop, south of the region, the influx is marked by the Budleigh Salterton Pebble Beds, and in the Midlands by the ‘Bunter Pebble Beds’, the latter now given a variety of local names (P948995). Between the outcrops in these areas, scattered boreholes in the south-west and north of the present region have encountered gravelly and pebbly beds at this stratigraphic level.

The top of the Triassic is now taken immediately below the first appearance of the ammonite genus Psiloceras, which occurs slightly above the base of the Lower Lias.

## Conditions of deposition

The Variscan orogeny created the floor of Palaeozoic rocks on which the Permian and Triassic sediments accumulated. The early stages in the process of erosion of this landmass cannot be reconstructed, but it is known that by early Triassic times the Coal Measures had, in places, been stripped off to expose Carboniferous Limestone. Thus, when traced from the east Devon coast towards Williton and Puriton, the basal Triassic conglomerates are found to contain an increasing quantity of pebbles of Carboniferous Limestone. In early Triassic times the Mendips and the Bristol Coalfield formed a hilly tract north of the Central Somerset Basin, with the west Somerset and Devon highlands on the west. In the north, another basin lay between the Malvern Fault Belt and the Vale of Moreton 'Axis'. The detritus from the eroded highlands, either borne by the wind or washed down by torrents after sudden storms, accumulated in the deeper parts of both these basins.

By late Triassic times a considerable thickness of sediment, comprising sandstone overlain by silty mudstone, had accumulated in this way. Thin beds of grey- green calcareous sandstone and silty sandstone ('skerries') in the latter indicate local, but often widespread, fluvatile and/or lacustrine incursions. At certain periods the concentration of brines by evaporation of saline lakes gave rise to deposits of gypsum and rock salt (halite), collectively known as 'evaporites'. At the same time, thick screes of angular and rounded rock debris accumulated on the mountain slopes and as outwash fans in front of the mountains, which flanked the basins. These deposits in the Bristol and Mendip areas are known as the Dolomitic Conglomerate (P006749). Within the areas of high relief, such as the Mendips, the debris filled narrow wadis, 100 m or more in depth, comparable in dimensions to present day gorges such as Burrington Combe or Ebbor Gorge. Individual boulders, many tons in weight, are present in the screes banked against steep cliffs of Carboniferous Limestone, and can, for instance, be seen in the Bridge Valley Road section in the Avon Gorge and along the coast between Portishead and Clevedon.

The Dolomitic Conglomerate, which has an extensive distribution, passes laterally into rocks varying from early to late Triassic in age and is therefore regarded as a diachronous marginal facies. It was found resting on Carboniferous rocks in the western part of the Severn Tunnel, and is well developed in the Portskewett–Caldicot area. South-west of Chepstow it attains a considerable thickness and forms the English Stones, Ladybench and other reefs and benches in the Severn Estuary, where it rests upon Coal Measures sandstone. Flanking the Carboniferous Limestone over much of Gwent and parts of Broadfield Down and the Mendips, however, the marginal facies consists in places of hard pink and yellow impure dolomite that apparently represents highly altered, much comminuted primary carbonate debris.

Where breccias derived from the larger uplands passed outwards onto the more deeply eroded surface of the Coal Measures, huge spreads of Dolomitic Conglomerate were deposited. For example, a 13 km-wide deposit extends northwards across the relatively flat surface of the Coal Measures from the foot of the Mendips.

By late Triassic times the accumulation of rock debris on the slopes of the areas of high relief, and the deposition of sand and silty mud in the interior basins, had created a great plain and substantially reduced the surface relief. The closing phase of deposition of the red mudstones was marked by an increasing number of green beds, which may indicate a gradual amelioration of the climate as humid periods became longer and more frequent. There is good evidence that the sculpting of the pre-Permian land surface was due to desert erosion. Where the red mudstones and

Dolomitic Conglomerate have been eroded away, the northern face of the Mendips rises at the present day as a great reddened wall of steeply dipping, patchily dolomitised limestone. Similar steep faces are found around Broadfield Down and in other denuded limestone hills. They are believed to be close to their Permian form. In the absence of a rainfall sufficiently persistent to maintain streams on the limestone areas or to remove the limestone in solution, stream erosion would tend to become concentrated on the softer and less pervious Coal Measures. In periods of long drought, wind erosion on the plain would also tend to maintain rather than reduce the slope of the limestone cliffs.

Well-rounded grains of quartz, of probable aeolian origin, and fragments of Carboniferous Limestone occur in the sandstone beds in the red mudstones. Together with extensive reddening of the sub-Permian rocks, they indicate desert conditions. Where the Dolomitic Conglomerate is absent and the red mudstones overlie the Coal Measures, a vivid red sandstone containing hematite (known as red ochre) commonly occurs at the base of the Mercia Mudstone Group. The hematite is believed to be derived from the oxidation of pyrite in the Coal Measures shales.

The fauna and flora of the New Red Sandstone indicate a terrestrial depositional environment. Few fossils are found in the red rocks. The bones of terrestrial reptiles, principally from fissure deposits, include small lepidosaurs and archosaurs, and include the sphenodontids Clevosaurus hudsoni and Kuehneosaurus latus. The deposits filling fissures in karst areas and palaeo-caves in Carboniferous Limestone are of uncertain age, but palynomorphs at one locality suggest a late Triassic age.

Fossils, including the crustacean Euestheria, the teeth of sharks (Hybodus) and the lung fish Ceratodus, and also trace fossils and plant remains including miospores, have been reported from the Arden Sandstone, the most widespread of the ‘skerries’ in the mudstone succession. A record of a unique tooth (Hypsiprymnopsis rhaeticus) from the late Triassic Blue Anchor Formation near Watchet, in west Somerset, was regarded by Boyd Dawkins (1864) as of mammalian origin.

Finally, in the late Triassic, the surface was inundated by the advancing waters of the Rhaetian sea, a widespread and important event usually called the Rhaetian Transgression. This heralded a period of marine sedimentation that was to last throughout most of the Mesozoic Era. The marine Rhaetian fauna, which appears in greatest numbers and variety in the black shale of the Westbury Formation, consists largely of thin-shelled bivalves, associated with echinoids, ophiuroids and gastropods. The succeeding Cotham Member of the Lilstock Formation marks the establishment of a shallow sea with a calcareous-mud floor or, locally, a lagoon only infrequently entered by marine organisms. When the water bodies dried out, mud-cracked layers were formed, while remaining pools of fresh or brackish water were colonised by algae, liverworts, crustacea and ostracods. Incursions by the sea led to the formation of thin beds with marine shells.

This period of intermittent marine incursions gave way to permanent marine conditions, represented by the Langport Member of the Lilstock Formation, and the Lower Lias.

Classification

Conditions of deposition

Permo-Triassic Sandstones

Mercia Mudstone Group

Penarth Group

## References


1. ↑ Warrington, G, Audley-Charles, M G, Elliott, R E, Evans, W B, Ivimey-Cook, H C, Kent, P E, Robinson, P L, Shotton, F W, and Taylor, F M. 1980. A correlation of Triassic Rocks in the British Isles. *Special Report of the Geological Society of London*, No. 13.

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