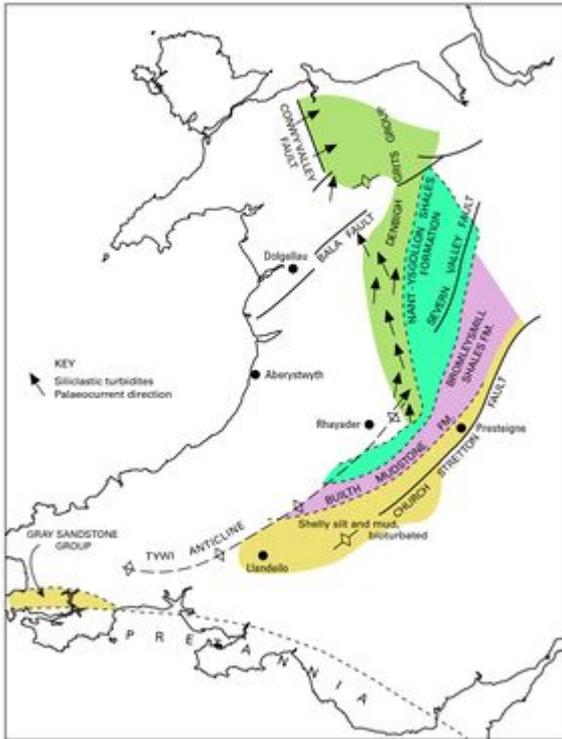


# Wenlock Series, Silurian, Wales

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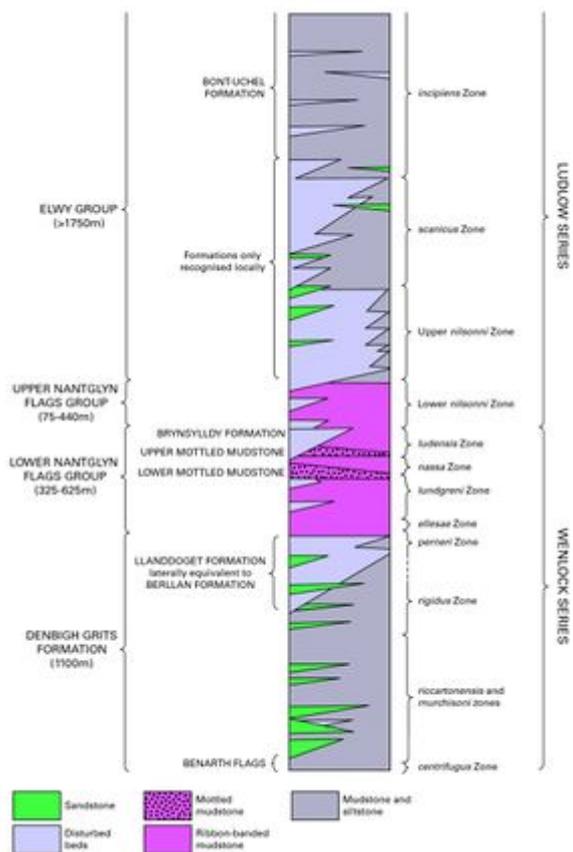
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Sedimentation patterns, early Wenlock  
(adapted from Cave and Hains, 2001).

P916172.



Generalised section through the Wenlock—Ludlow rocks of the Denbigh area (adapted from Warren et al., 1984). P916173.



Three Chimneys, Marloes Bay. Prominent sandstone beds are separated by softer, weathered silty mudstone, near top of Skomer Volcanic Group (Llandovery) (MFH P662418).

Wenlock strata form extensive outcrops throughout Wales. From the vicinity of Conwy in the north, they can be traced southwards and eastwards around the Denbigh moors into the core of the Central Wales Syncline, west Berwyn Hills. From there the Wenlock outcrop extends south to Llandrindod Wells, and from there to the south-west forming a narrow impersistent outcrop along the eastern limb of the Twyi Anticline into Pembrokeshire. In addition, Wenlock strata crop out in inliers at Cardiff and Usk.

The late Llandovery marine transgression had, by early Wenlock times, established an extensive

shelf sea across the Midland Platform ([P916172](#)). West of the platform, a broad Welsh Basin extended from Pembrokeshire to Denbighshire, and this may have become shallower farther to the west with possible emergence. However, the dominant source of sediment transported into the basin was from the landmass of Pretannia to the south.

In early Wenlock times, there was restricted deposition of carbonates in the Welsh Borderland but this became more widespread with the accumulation of the Much Wenlock Limestone Formation, of late Wenlock age, across the Midland Platform. It is here, near Much Wenlock, that the boundary stratotypes for the base of the Wenlock Series and its stages were established. At localities on either side of the border, there is evidence of overstep at the base of the Wenlock. For example, at Presteigne, a basal algal- and bryozoan-rich limestone rests on lower Llandovery strata, and at Old Radnor it rests on Precambrian. However, in early Wenlock times, muddy and variably calcareous sediments, the Buildwas and Coalbrookdale formations, were deposited across most of the shelf. The carbonate element diminishes towards the basin edge; the shelf mudstones contain a rich shelly fauna of brachiopods, trilobites and corals, and a sparser graptolite fauna.

Within the basin, in the Rhayader area, alternating burrowed, mottled and laminated mudstone spans the Llandovery–Wenlock boundary (Dolfawr Mudstones Formation), and hemipelagites of the Nant-ysgollon Mudstone Formation mark a return to oxygen-poor bottom conditions and deeper water ([P916172](#)). These slope apron sediments were gradually overwhelmed by deposition of muddy turbidites, seen in the upper part of the Nant-ysgollon Mudstone Formation and in the contemporaneous Penstrowed Grits Formation farther east, part of an extensive sandstone lobe facies that was supplied from the south. The medium- to thick-bedded, high-matrix turbiditic sandstones, similar to those of the Llandovery, are interbedded with thin siltstone turbidites, laminated hemipelagites and few bentonites. The abundant bioclastic debris reflects the proximity to the eastern shelf edge. The grits are the youngest and most easterly sandstone-lobe facies in the southern part of the Welsh Basin. Major slump sheets in the Builth Mudstones Formation developed from steep, west-facing slopes and syndepositional movement, for example on the Garth Fault. The mudstones are dark, blue-grey, laminated and graptolitic; they reflect a further deepening of the basin and anaerobic conditions, which were largely sustained throughout the Wenlock.

Around Montgomery, the Bromleysmill Shale and Aston Mudstone formations similarly define the basin to shelf transition. Non-bioturbated mudstone in the vicinity of Gregynog passes laterally to the south-east into intensely bioturbated and homogenised mudstone with thin limestones in the proximity of Bishop's Castle at the edge of the Midland Platform.

Through most of central and north Wales, the basal sequence was dominated by the northwards transport of turbidites ([P916172](#)). In Denbighshire, Wenlock strata define the broad syncline between the Conwy valley, in the west, and the edge of the Vale of Clwyd, in the east; small outcrops occur farther east in the Clwydian Hills. The Denbigh Grits Formation ([P916173](#)) is thickest in the Llanrwst district and thins eastwards into the Clwydian Hills. It comprises an alternation of sandstone, grey and dark grey siltstone and mudstone (striped beds) and disturbed beds. The sandstone ranges from fine grained through to coarse grained and pebbly. The proportions of the various lithologies vary markedly, both vertically and laterally. Thick sandstones occur only in the lower half of the succession. The poorly sorted sandstones with an abundant clay matrix, graded bedding and current structures are typical turbidity current deposits. Both proximal and distal deposits have been distinguished. In contrast to the outcrops farther south, transport was from the west to south-west, and was possibly influenced by the scarp of an active Conwy Valley Fault. Disturbed beds are the predominant lithology of the Berllan and Llandoget formations. They include a complete spectrum of lithologies, and vary from contorted to completely destratified strata resulting from subaqueous slumping, initiated either by seismic shock or by the rapid loading of sediment onto a water-saturated layer.

As the sandstone lobe facies moved westwards in late Wenlock to early Ludlow times, anoxic mud (Nantglyn Flags Formation) was deposited on the slope apron. The formation is dominated by regular alternation of turbiditic, silty mudstone and laminated muddy siltstone bands with locally developed thin calcareous siltstone (ribbon-banded mudstone); calcareous concretions form in discrete layers. Current data indicate that most of the sequence was transported from the west, although the calcareous siltstones indicate derivation from a southerly source. Towards the end of Wenlock times these patterns were interrupted by two episodes during which shelly and bioturbated mottled mudstone was deposited over much of the basin, probably in response to a global marine regression that caused a temporary return to oxygenated depositional conditions and colonisation of the sea floor by benthic organisms.

South-west from Builth Wells towards Llandeilo, along the southern limb of the Tywi Anticline, calcareous mudstone, sandstone and impure limestone become progressively more apparent. The strata contain the distinctive shelly faunas of the shelf facies of the Welsh Borderland. Also in this direction, upper Wenlock strata (Homerian) overstep lower Wenlock strata (Sheinwoodian) on to Llanvirn shales just east of Llandeilo and beyond, reflecting continued tectonic activity along the Tywi Lineament.

In south-east Wales, Wenlock strata crop out in an inlier in the suburbs of Rumney and Pen y Lan in Cardiff and in the core of the anticline in the Usk inlier. At Cardiff, the lowest strata are typically grey-green mudstones, calcareous and silty in places, with thin sandstone bands (Pen y Lan Mudstones). The sandstones are fine grained with planar bases and diffuse and wave-rippled tops. The sequence contains a rich shelly fauna of late Wenlock (Homerian) age, and occupied a shallow marine, mid-shelf environment. The sandstone and bioclastic limestone beds were probably storm induced. The mudstones are sharply overlain by a pebbly, cross-bedded, fine- to coarse-grained sandstone (Rhymney Grit), which lies at the base of a sequence of sandstone, siltstone and mudstone with few thin limestones, conglomerates and an ironstone (Cae Castell Formation). The basal sandstone, containing laminae of carbonaceous debris, was deposited during a temporary shallowing of the marine environment and is interpreted as a subtidal sand bar.

The Wenlock calcareous mudstone and siltstone in the core of the Usk inlier (Glascoed Mudstone Formation) are similar to those at Cardiff. The generally offshore character of the mudstone is progressively replaced by facies with nearshore and possibly lagoonal features, and clastic and carbonate deposition in the overlying silty sandstone (Ton Siltstone Formation) and limestone (Usk Limestone). The limestones are the most southerly development of carbonate precipitation in the late Wenlock.

In south Pembrokeshire, Wenlock strata are exposed in small inliers between Freshwater East and Marloes. At Marloes and Wooltack, the lowest Wenlock strata comprise a thin sequence of blue-grey and green siltstone, mudstone and calcareous sandstone near the top of the Coralliferous Group (late Llandovery to early Wenlock age) which unconformably overlies the Skomer Volcanic Group. The strata contain a rich shelly fauna that are typical of a shelf environment, including the brachiopods *Costistricklandia lirata lirata* and *Eocoelia sulcata*, and the coral *Palaeocyclus porpita*. These beds pass up into flaggy bedded sandstone and siltstone with softer brown and grey sandy mudstones that included thin weathered rottenstone bands (Gray Sandstone Group), which are well exposed (apart from the base) south of the prominent Three Chimneys in Marloes Bay ([P662418](#)). Fossils are generally rare, but can be common in some rottenstones, particularly in the lower part of the succession, where they include brachiopods and corals that suggest an early to mid Wenlock age. Higher beds have yielded a more restricted fauna with inarticulate brachiopods (*Lingula* sp.) and indeterminate bivalves that are not diagnostic of age, but these beds are probably still Wenlock. The sequence coarsens upwards, and ripples, scours and cross-bedding are common throughout. It is interpreted as a transition from a marine to shallow marine environment with deltaic incursions

and some intertidal influence. Interbeds of red sandstone occur with increasing frequency, reflecting the establishment of a fluvial floodplain environment in the Old Red Sandstone facies that forms such a prominent feature at the western edge of the bay.

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