Ordovician, introduction, Wales

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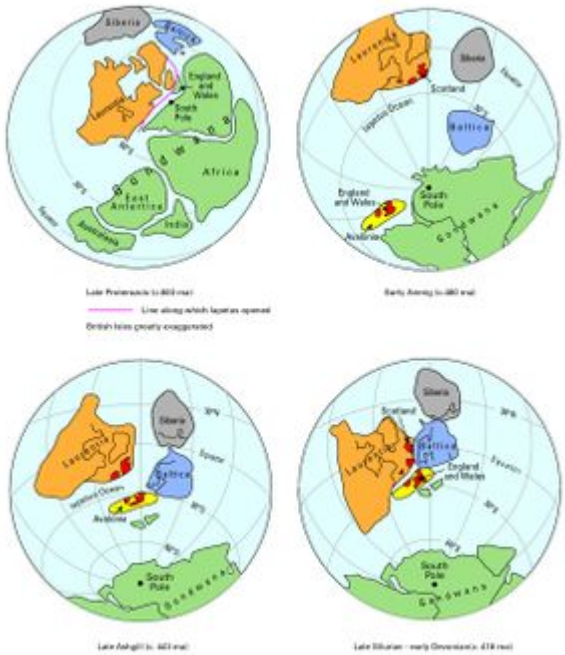
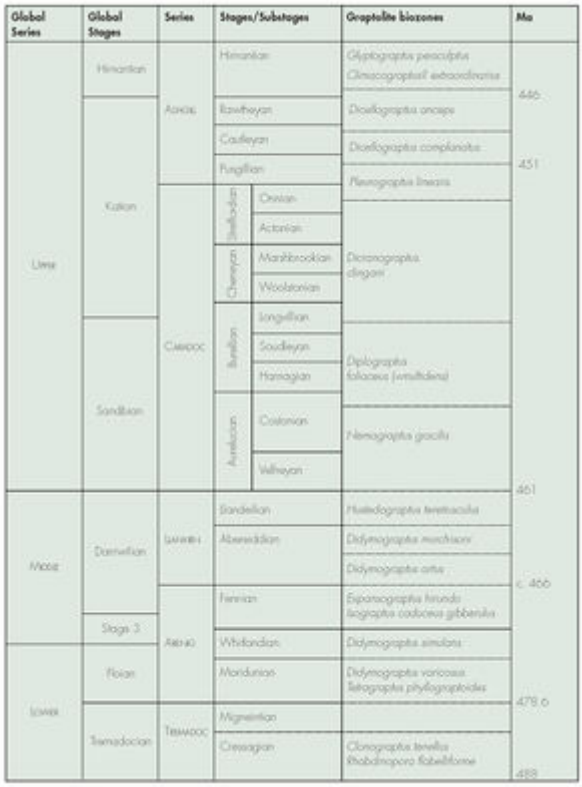
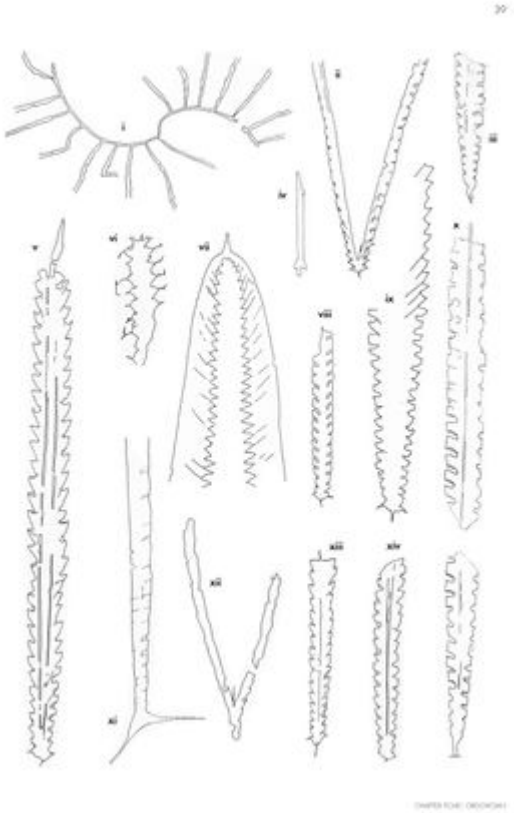


Distribution of continents in Late Proterozoic and early Palaeozoic time. Note: England and Wales are greatly exaggerated in size (adapted from Mitchell, 2004). P916144.



Ordovician series. P916227.


Ordovician (Llanvirn and Caradoc) graptolites from Wales. i *Nemagraptus gracilis* (Hall) (X3); ii *Dicellograptus intortus* Lapworth (X4); iii *Normalograptus pollex* Zalasiewicz and Rushton (X5); iv *Corynoides* aff *curtus* Lapworth (X5); v *Orthograptus* ex gr. *calcaratus* (Lapworth) (X5); vi *Lasiograptus harknessi* (Nicholson) (X5); vii

Didymorgraptus murchisoni (Beck) (X4); viii *Pseudoclimacograptus angulatus sebyensis* Jaanusson (X5); ix *Diplograptus foliaceus* (Murchison) (X5); x *Ensigraptus* cf. *caudatus* (Lapworth) (X5); xi *Diplacanthograptus spiniferus* Ruedemann (X5); xii *Dicranograptus clingani* Carruthers (X5); xiii *Hustedograptus teretiusculus sensu* Elles and Wood (X4); xiv *Amplexograptus arctus* Elles and Wood (X5). P916153.

Introduction

Ordovician strata form extensive outcrops throughout Wales in which the sequence shows remarkable lateral variation in thickness and lithological content. The form of the Welsh basin throughout Ordovician times remained broadly similar to that which had been established in late Precambrian times. However, the influence on the pattern of sedimentation of both the Irish Sea Landmass in the north-west and the Midland Platform in the south-east was periodically affected by sea level changes. Mudstone deposition, probably the result of sea-level rise, was widespread through the Tremadoc but the bioturbation and lower carbonate content suggest more oxygenated water than previously. Sea level fluctuated in the basin throughout Tremadoc to Llanvirn times, followed by a major transgression on to the adjacent platform in early Caradoc times (the *gracilis* Biozone transgression). Subsequent lowering of sea level, with low stands in late Caradoc and Ashgill times, was probably caused by glaciation centred on the Gondwana continent. The sequence is dominated by blue-grey mudstone and siltstone with local development of conglomerates and sandstones in nearshore settings and dark grey to black anoxic silty mudstone in distal deep water. The major difference in the sedimentation patterns from the Cambrian was the marked diminution in the influence of turbidites, at least until late Ordovician times when turbiditic and associated sediments that are more characteristic of the Silurian were first deposited. Most importantly, the repeated sequences of volcanic rocks reflect the intense volcanic activity that profoundly modified the local sedimentation patterns through most of Ordovician time. The volcanic activity was facilitated by major deep-seated faults and thinning of the crust at the northern edge of Avalonia. The earliest volcanism, during Tremadoc times, was that of an island arc, related to subduction of Iapetus ocean crust to the north, at the margin of Avalonia. Subsequent volcanism, in Llanvirn and Caradoc times, developed within an extensional back-arc setting.

All but one of the series of the Ordovician used in southern Britain — Tremadoc, Arenig, Llanvirn, Caradoc and Ashgill — were defined in Wales and its borders in the 19th and early 20th centuries, although the Tremadoc was originally placed within the upper Cambrian. These series subdivisions can be applied to the Ordovician of continental Europe and Asia, which lay on the Gondwana plate on the south-east side of the Iapetus Ocean, but are less easily applied to those sequences in northern Britain, North America and Greenland, which lay on the Laurentian plate, on the north-west side of Iapetus (P916144).

As currently defined and ratified by the IUGS, the base of the Ordovician System is defined at the base of the Tremadoc Series (Tremadocian Stage of current nomenclature), at a level just below the first appearance of the planktonic dendroid graptolites of the genus *Rhabdinopora* [*Dictyonema*], and the top coincides with the base of the acuminatus Biozone at the base of the Silurian. Subdivision of the Ordovician System into global series and stages is nearing completion with only one of the global stages derived from the Anglo-Welsh divisions. Historically the Ordovician System in Wales has been divided into five series, with their constituent stages and substages, on the basis

of graptolites and shelly fauna (P916227); (P916153). The graptolites occupied the water column and are generally found in offshore, pelagic, dark grey or black, pyritous and carbonaceous mudstones, which reflect anoxic bottom water conditions and deeper water. Conversely, the well aerated, relatively nearshore sandstone, mudstone and calcareous sediments were an attractive habitat for the shelly faunas. The great variety of shelly fossil assemblages facilitates local detailed correlation, but the interplay between evolution and migration due to changing environmental conditions demands careful interpretation. Because of the separation of the two environments, it is not surprising that correlation between graptolite and shelly faunas can be imprecise. However, there are places in outer shelf settings, as at Builth Wells, where graptolites are mingled with deep benthic faunas containing trilobites. Locally bryozoa, ostracods and echinoderms were common. They provide particular evidence of the rich faunal communities that were established in warm clear seas during Ashgill times.

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