Dinantian, introduction, Carboniferous, Wales

Vertical sections illustrating the Dinantian of south Wales (adapted from Waters et al., 2007). P916181.

Facies variation in the lower Dinantian of south Wales (adapted from Wright, 1996). P916182.

The marine intercalations in the Upper Old Red Sandstone sequence in south Wales are the first indications of the more general subsidence of the area and the northward marine transgression that became established in early Carboniferous times. The repeated fining-upwards alluvial/fluvial red beds of the continental Old Red Sandstone gave way to grey, richly fossiliferous, calcareous mudstone and limestone in early Dinantian times. Coincidentally, there was a distinct change from an arid climate through semi-arid to monsoonal in late Dinantian times. Over much of south Wales, where the Dinantian rocks overlie the Upper Old Red Sandstone, the boundary is conformable and gradual, but locally there is overlap on to older strata.

A Vaughan’s original zonal scheme of Dinantian strata was based on coral and brachiopod assemblages, and because the south Wales succession is similar to that in the Avon Gorge, in
Somerset, it was initially referred to as Avonian. Recently it has been shown that the type section in the Avon gorge is incomplete and that coral assemblages were influenced by the lithofacies. Consequently, correlation between different basins is difficult. In 1973, W H C Ramsbottom proposed that the sequence could be divided into six major cycles, or mesothems, distinguished on sedimentary features and faunal and floral assemblages, each cycle indicating a marine regression and transgression of global eustatic significance. The topmost two cycles were divided into a number of minor cycles, or cyclothems. Later biostratigraphical work modified the mesothem boundaries, which T N George and co-workers used as the basis of the Dinantian stage boundaries, although the stages are defined on faunal evidence and not primarily on the cycle boundaries. The concept of the major cycles stimulated much discussion and, the current consensus is that such broad regional facies changes would be obfuscated by facies patterns caused by local, vertical fault movements.

In recent years, it has been shown that the detailed stratigraphy is far more complex than previously envisaged. The stratigraphy has been refined on evidence from the study of conodonts and foraminifera. In addition, detailed study of petrography and textural variation within the limestones and their accurate classification has facilitated a clearer understanding of the environmental changes.

Dinantian strata in south Wales form a broad outcrop in the limbs of the folds in south Pembrokeshire, Gower and the Vale of Glamorgan and a narrow outcrop along the north and east crop between Pembrokeshire and Monmouthshire. In north Wales, the sequence is well exposed about the north-east coast of Anglesey, in the cliffs of Great Orme’s Head and Little Orme’s Head enclosing Llandudno Bay, in the scarp from Colwyn Bay into the Vale of Clwyd, and from Prestatyn to south of Llangollen, on the east side of Halkyn Mountain.

The Dinantian sequence in south Wales is part of the Southern Province, and accumulated at the southern edge of the Wales–Brabant Massif. It has been subdivided into the Avon Group and Pembroke Limestone Group. The distribution of facies was controlled by a combination of sea level rise and differential subsidence, which led to the formation of a carbonate ramp. On the landward side of the ramp, bioclastic and ooidal grainstones and peritidal carbonates reflect transgressive and regressive events, with much evidence of subaerial exposure. In the mid-ramp zone, the sequence of bioclastic packstones and wackestones is much thicker, and accumulated in deeper water below fair-weather wave base. Graded beds indicate storm-influenced deposition and, during transgressive phases, back barrier peritidal facies developed. Across the outer side of the ramp, the thickest sequences accumulated below storm wave base, and bioclastic mudstone and wackestone are associated with reef mounds. In north Wales, at the northern edge of the landmass, a broadly similar sequence accumulated at the edge of the Pennine Province, and it was profoundly influenced by movement along pre-existing fracture zones, including the Welsh Borderland, Bala and Menai Straits fault zones. In detail, the sequence there is more clearly related to that of central and northern England.

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