Cretaceous of Wales

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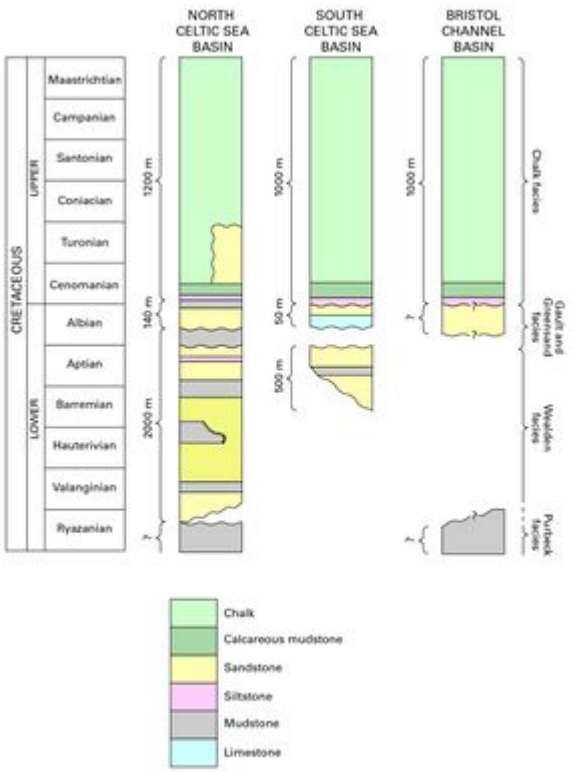

Correlation of Cretaceous lithologies (after Tappin et al., 1994). P916207.

Introduction

During the Cretaceous Period, over some 77 million years, there were marked changes in the sedimentary patterns that were due to a combination of eustatic sea-level changes and regional tectonic activity. There is evidence of Early Cretaceous uplift in the St George's Channel Basin, but the most profound change occurred across the Lower–Upper Cretaceous boundary at about 99 Ma. Prior to this time, tensional activity caused rifting and block faulting, which was most graphically expressed in the Rockall Trough, off north-west Scotland, and in the North Sea. Subsequently, this activity ceased and deposition of a widespread blanket of coccolith ooze (chalk) was initiated.

At the present time there are no Cretaceous rocks on mainland Wales, but they are preserved south of the Variscan Front in the North Celtic Sea, South Celtic Sea and Bristol Channel basins (P916207); for the most part these basins were those that controlled Jurassic sedimentation. North of the Variscan Front, it is possible that Lower Cretaceous rocks are preserved in the axial part of St George's Channel Basin, but as yet they have not been proved. A marked fall in sea level in early Cretaceous times exposed much of the British Isles to terrestrial deposition. At the same time, rifting continued to the south and south-west of Wales, and the supply of coarse clastic sediments into the basins was maintained. However from mid Cretaceous times, extensional stress waned, the area subsided and the sequence became progressively marine, overstepping the basin margins.

The thickest sequence, about 3300 m, preserved in the North Celtic Sea basin, spans the complete zonal range of both the Lower and Upper Cretaceous. Less complete sequences occur in the South Celtic Sea and Bristol Channel basins. Four main facies associations have been determined.

Lower Cretaceous

In the North Celtic Sea Basin, the freshwater lagoonal Purbeck facies comprises grey calcareous mudstone with sandstone and thin limestone beds. In the Bristol Channel Basin, silty mudstone and limestone with some gypsum beds have been recorded. The sequence is similar to that in southern England. The Cinder Bed has been identified on logs; this is a marker horizon rich in oyster debris that was formerly taken as the base of the Cretaceous.

The Wealden facies in both the North Celtic Sea and South Celtic Sea basins comprises mudstone, siltstone, silty and muddy sandstones with thicker quartzose sandstone beds, coals and lignites in places. In the South Celtic Sea Basin, the sequence unconformably Middle Jurassic strata. It is less calcareous and less fossiliferous than the Purbeck facies and, unlike the latter, sphaerosiderite is common. The main source of clastic debris was Wales and south-west England, and the sequence accumulated in brackish and fresh water fluvial and alluvial systems; the thicker sandstones are probably distributary sand bodies.

In the Bristol Channel Basin, Wealden strata have been determined in many boreholes along the axis of an east–west-trending syncline that formed during early Cretaceous times. The mottled red-brown and grey mudstones and siltstones are characteristically noncalcareous and, in the eastern part of the basin, interbedded sandstones and mudstones have been interpreted as alluvial deposits. Detailed sedimentological analysis indicates deposition in a floodplain environment with high and fluctuating water tables, and high-energy distributary channels. Wealden Clay mineral assemblages are dominated by kaolinite, chlorite and mica, but at the Purbeck–Wealden transition kaolinite is absent, attributed to changes in the weathering processes in the hinterland. Smectite is present, derived, in part at least, from the alteration of volcanic ash.

During late Lower Cretaceous times, local subsidence was greatest at the south-west end of the North Celtic Sea Basin with the deposition of up to 140 m of Gault and Greensand facies, of Albian age. No equivalent sequence has been distinguished closer to the Welsh coastline. In the eastern part of the South Celtic Sea Basin, shallow-water clastic sedimentary rocks and limestones are exposed at the sea bed, and many of the boreholes proved calcareous glauconitic siltstone and mudstone with several prominent limestones. In the Bristol Channel Basin, thin Gault Clay was determined in one borehole.

Upper Cretaceous

Early in the Late Cretaceous the coincidence of regional subsidence and high sea level led to the widespread deposition of chalk, a limestone composed mainly of the microscopic remains of planktonic algae (coccoliths). By latest Cretaceous times this sea extended far beyond previous limits and covered most of England and Wales with the possible exception of a small island about west and north Wales. Subsidence was more regional than during Early Cretaceous times and thick sequences continued to accumulate within the pre-existing basins rather than on the intervening highs, but this was probably more to do with differential compaction than tectonic activity.

In the South Celtic Sea and Bristol Channel basins, the lowest part of the Upper Cretaceous (Cenomanian) comprises calcareous, glauconitic sandstone, which grades up from the underlying Lower Cretaceous (Albian), and is similar to the gradation observed in many areas of southern

England. The sandstone is overlain by glauconitic limestone or calcareous mudstone (Glauconitic Marl), which in turn is overlain by similar mudstone with intercalated siltstone (Chalk Marl[1]). Chalk sedimentation was diachronous across the region from mid-Cenomanian times. On basin margins deposition of glauconitic sediment continued into the Coniacian. The Chalk is white and hard with minor glauconite and quartz sand, and the influx of planktonic foraminifera corroborates deeper water conditions.

The lowermost unit of the Middle Chalk consists mainly of hard, nodular chalk with interbedded calcareous mudstone. It is closely comparable with the equivalent Melbourne Rock onshore, and has been distinguished in all the offshore basins south of the Variscan Front. Higher in the sequence, the lithologies revert to softer, more argillaceous chalk, which again bears similarities to the onshore equivalent. The geophysical reflector that elsewhere marks the base of the Upper Chalk has not been recognised and this unit is less clearly defined than the lower sequences. The base has been palaeontologically determined in the South Celtic Sea and Bristol Channel basins. Above the base, the chalk becomes progressively softer, although interbedded hardground and flint layers are picked out on the geophysical logs. The well-defined foraminiferal faunal changes across the stage boundaries are coincident with slight changes in chalk lithology.

1. ↑ The revised stratigraphical nomenclature that has been applied to the Cretaceous sequence in the south of England has not yet been applied to the offshore succession.

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