Fedw Fawr

NRW RIGS no. 234 [SH 58631 81457]

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RIGS Statement of Interest:

Fedw Fawr RIGS site provides an important section through the lower portion of the cyclical late Asbian sequence of the Penmon area, permitting detailed comparison with RIGS JRD 6. Each cycle was initiated by a marine transgression, records a progressive shoaling-upwards, and is capped by a palaeokarstic surface; the latter testifies to a period of dissolution in response to subaerial exposure. The limestones immediately underlying such surfaces display a complex array of textures and effects associated with plant colonisation and soil formation — features which fall under the general term of calcrete. The section at Fedw Fawr was critical in the development of a process-driven model for the sequential and spatial evolution of these features which has applications not only to the Dinantian succession in North Wales, but to a broader understanding of calcrete formation (Davies, 1991). This RIGS provides a section through the Tollhouse House Mudstone marker bed and is additionally important in exposing the margin of a fluvially incised channel and its late Asbian clastic fill — the Fedw Fawr Sandstone.

The Anglesey succession as a whole records the progressive growth of a carbonate platform during a pulsed Dinantian transgression. A wave-cut platform at the western end of the section [SH 6000 8220] exposes early Asbian porcellaneous limestones at the top of the Leete Limestone Formation as seen at RIGS JRD 10. The cliffs and quarry benches above this level allow for careful analysis of the succeeding late Asbian limestone cycles. Five cycles are exposed, but it is the lower three which provide the greatest insight. Grainstone textures predominate in these cycles, but the upper levels of each cycle comprise coarser, cross-bedded facies containing imbricate shell coquinas and rolled corals. The top of each cycle is defined by a well developed palaeokarstic surface. The lowest of these surfaces, stripped bare of the overlying strata, forms the prominent rock bench located 3 m above the base of the section. It displays superbly the typically pitted and hummocky form of such surfaces with a vertical relief of 0.6 m. Some of the hummocks have a veneer of finely laminated dark grey clacrete, and the grainstones below contain abundant dark brown, branching tubular structures formed by the calcification of fossil roots and termed rhizocretions (Davies, 1991). At the base of the cliffs above this surface is a thin, pale grey, clay palaeosol (a fossil soil). About 2 m above this is a second palaeokarstic level, but one which displays marked lateral variation within the exposed cliff section. At the eastern end of the exposure, welded on to the cross-stratified grainstones at the top of the second cycle are grainstones at the base of the third cycle — the cycle boundary is scarcely discernable as a bedding feature. However, rhizocretions visible within the uppermost part of the second cycle terminate at the base of the overlying unit and provide unequivocal proof of subaerial exposure and plant colonisation at this level. As this horizon is traced westwards, a laminated calcrete crust appears at the contact between the two cycles; further west an overlying clay palaeosol appears infilling shallow pits up to 0.5 m deep. In association with these lateral changes the underlying limestone bed converts into a rubble of irregular limestone blocks into which the overlying clay has infiltrated.

The lateral relationships observed at this site influenced Davies (1991) in his development of a model for the formation of palaeokarstic surfaces and calcretes within the Anglesey Dinantian succession. During the periods of lowered sea level and emergence of the platform recorded by such features the unlithified carbonate sediment of the previously deposited cycle underwent dissolution and digenesis promoted by semi-arid climatic conditions. This saw periods of intense evaporation alternate with rainy seasons and the downward migration of vadose ground waters. Initially, following emergence, the roots of colonising land plants penetrated the loose sediment. On their death, dark carbonate cements were deposited as a sheath around the decaying structures to form rhizocretions. The subsequent lithification of the sediment prevented root colonisation, but favoured the growth of laminated calcrete crusts on the now solid limestone surface. Wind blown dust, much of it volcanic in origin, accumulated on this surface to form simple soils. Rain waters percolating through this clay cover dissolved the limestones beneath to create the characteristic hummocky and pitted palaeokarstic relief.

Locally, the newly formed limestones suffered fracturing and brecciation. This allowed rain waters to penetrate to deeper levels, promoting secondary phases of cementation and calcrete crust formation, but also the downward infiltration of clay palaeosol material. Davies (1991) recognised that these processes could operate sequentially at a single site such that simple profiles marked only by rhizoliths could be viewed as immature, in contrast to more mature and complex profiles characterised by deep rubbly zones and secondary phases of calcretisation. However, the Fewd Fawr RIGS exposures were important in clearly showing that such contrasting profiles could also exist in close proximity to one another along the same palaeokarstic level. This prompted Davies (1991) to suggest that shallow depressions, into which surface drainage was directed and clay palaeosol material was washed, were likely to become sites of more complex profile development, whereas simple profiles would typify the adjacent highs. Cliffs in the centre of Fedw Fawr cove [6053 8191] expose fluvial conglomerates overlain by an estuarine sequence of interbedded sandstones and mudstones, all facies of the Fedw Fawr Sandstone (Greenly, 1919; Davies, 1983, 1994). This clastic sequence infills a deep channel which was cut through the cyclical late Asbian sequence seen to the west. Cliffs forming the western side of the cove reveal the steeply inclined margin of this feature, excavated by resurgent fresh water streams flowing across the Dinantian platform surface during one of the cycle-defining periods of subaerial exposure. Regional correlations suggest that this period of late Asbian incision and fill equates with that recorded by the Helaeth Sandstone of RIGS JRD 6 (Davies, 1983).

Geological setting/context: The Dinantian succession of North Wales records the evolution and growth of a carbonate platform founded on the older Palaeozoic and Precambrian rocks of the region in response to pulsed, but sustained marine transgression (George, 1958, 1974; Somerville & Strank, 1989; Davies et al., 2004). The Dinantian sequence on Anglesey was deposited during the latter phases of this event, during the Asbian and Brigantian stages. Late Asbian and younger parts of the succession are cyclic in character; constructed from a series of shoaling up-wards limestone sequences each capped by a palaeokarstic surface. The latter are well seen in the Fedw Fawr RIGS which was influential in the development of a model for the formation of such cycle-defining surfaces and associated calcrete-related phenomena (Davies, 1991).

The site forms one of series of 9 selected to illustrate the Anglesey Dinantian succession and the processes, erosional, depositional and diagenetic, which were active during and subsequent to its accumulation; these in turn from part of a broader network of Upper Palaeozoic RIGS in North Wales.

References:

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Site geometry: Site boundary