Pedolau to Eglwys Siglen RIGS Site

NRW RIGS no. 381 [SH 51231 86885]

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RIGS Statement of Interest:

Pedolau to Eglwys Siglen exposes late Asbian transgressive-regressive cycles with subaerial exposure, karstic dissolution and soil formation.

Within the Anglesey Dinantian succession, the Pedolau to Eglwys Siglen RIGS provides excellent exposures of typical late Asbian transgressive-regressive carbonate cycles including evidence, at the tops of each cycle, of penecontemporaneous subaerial exposure, karstic dissolution and soil formation. It also includes a unique section in the Helaeth Sandstone, a sequence of fluvial conglomerates, estuarine mudstone and barrier beach sandstones. The Anglesey succession as a whole records the progressive growth of a carbonate platform during a pulsed Dinantian transgression. The late Asbian sequence on Anglesey, as elsewhere in North Wales and beyond, comprises a series of shoaling-upwards carbonate cycles each capped by a palaeokarstic surface. The latter record repeated falls in sea level (forced regressions) and the resulting subaerial exposure of the platform. The intervening rises in sea level (marine transgressions) flooded these surfaces, re-submerged the platform and initiated the next cycle of carbonate sedimentation. During the emergent phases, the sediment exposed at the platform surface underwent complex diagenetic changes associated with carbonate cementation, but also with soil formation (pedogenesis) and plant colonization. The resulting structures and fabrics are typical of modern day calcretes formed under a semi-arid tropical climate. Wind-blown volcanic ash was also trapped and accumulated on the platform surface and, beneath this derived soil cover, the newly lithified limestones were prone to dissolution by downward percolating rain waters. The resulting complex array of dissolution, diagenetic and pedogenetic features displayed by the Anglesey palaeokarstic surfaces and their immediately underlying strata, have been described, illustrated and interpreted in detail by Davies (1991). Many of these phenomena are displayed by the Pedolau to Eglwys Siglen RIGS. Key amongst these are hummocky surfaces formed by dissolution below a still preserved volcanic (bentonitic) clay fossil soil (or palaeosol); calcified root structures termed rhizocretions; laminated calcrete crusts and ooids; limestones altered to dark grey micrite; and growths of replacive microspar. In thin-sections, additional microscopic features such as early vadose cement fabrics and a range of brecciation and neomorphic replacement effects are also evident (Davies, 1991). In addition, the Anglesey Dinantian succession provides exclusive evidence that, during periods of subaerial exposure, freshwater streams flowed on to the Dinantian platform surface and incised channels into the underlying limestones. Sequences of fluvial, estuarine and marine siliciclastic facies were deposited, and are now preserved, within the confines of these features. The Helaeth Sandstone, which has its type section within the Pedolau to Eglwys Siglen RIGS, provides one of the best and most easily accessible sections through such a sequence and was important in the development of a depositional model for these channel-fills (Davies, 1983; 1994). Strata exposed at, and to the east of Pedolau [SH 5082 8708] comprise a sequence of thin-bedded limestones with a distinctive ‘clotted’ texture and a product of their extensive replacement by microspar. These rocks are capped by a complex and mature palaeokarstic surface which displays evidence of fluvial incision and of more than one phase of subaerial exposure. A dark grey estuarine mudstone occupies an asymmetric channel incised through this surface, the mudstone pinching out to the south-east against the rising channel floor. Here [SH 5100 8700] calcretised conglomerates rest on highly altered, brecciated and rubbly limestones with associated laminated calcrete crust and ooids. These various features are preserved beneath a grey clay palaeosol with fossil rootlets and a thin coal. This palaeokarstic level broadly equates with the youngest strata observed within the Lligwy Bay Disturbance and the latter may have formed in response to dissolution and fluvial incision during the same period of subaerial exposure (see RIGS JRD 5). To the east, at the western side of Porth Helaeth [SH 5102 8695], are exposures in pebble conglomerates with low-angle lateral accretion surfaces, resting on a beveled limestone surface and locally infilling shallow potholes. An overlying, thick-bedded conglomerate unit displays trough cross-bedding. These rocks from part of the Helaeth Sandstone (Greenly, 1919; Davies, 1983) and provide evidence of quarrying for millstones. At the base of cliffs on the eastern side of Porth Helaeth [SH 5108 8683] to [SH 5136 8682] are further exposures in this

sandstone division. Here, at the base, a distinctive sequence of highly lenticular, hummocky cross-stratified, calcareous sandstone beds dip steeply to the south beneath a flat-lying truncation surface. Above this a thin sequence of limonitic mudstones with thin, tabular sandstone beds, underlies a capping unit of planar- and cross-stratified calcareous sandstones with cut-and-fill structures, skolithus and diplocriterion escape burrows, shell coquinas, and granule and pebble lags. The Helaeth Sandstone exposures display the full range of facies associated with the fluviallly incised channel features developed within the Anglesey Dianntian sequence. The conglomerates of the western exposures are of fluvial origin and record deposition by braided rivers, but with meandering reaches (Davies, 1983). The eastern cliff section comprises facies deposited during the drowning of the channel as protective barrier spits were driven landwards across estuarine mud flats. The uppermost facies display sedimentary features and trace fossils typical of beaches and near shore bars. Typical late Asbian limestone cycles, occurring above the Helaeth Sandstone, are well exposed in cliffs to the east [SH 5136 8682] to [SH 5170 8695] in the vicinity of Eglwys Siglen. In contrast to younger Brigantian cycles (see RIGS JRD 7) these older examples are constructed principally from thick-bedded, pseudobrecciated and mottled, skeletal and peloidal packstones. However, below capping palaeokarstic surfaces, thin units of well rounded and sorted skeletal grainstones rich in dasycladacean algal plates are commonly preserved (Davies, 1983; 1984; 1991). This succession of facies within individual cycles reflects an upward decrease in the amount of interstitial carbonate mud preserved the larger skeletal and peloidal grains consistent with increasing energy conditions and decreasing depth of water. The lower packstone facies record deposition below fair-weather wave-base where mud was only partially winnowed and bioturbating benthos was able thoroughly to mix the sediment. In contast, the well sorted grainstone units at the tops of the cycles record the effective winnowing and removal of mud grade sediment which takes place in setting above fair-weather wave base subject to constant agitation. This upwards shallowing of facies was a response to falling sea-level and culminated in subaerial exposure of the cycle top. Hummocky dissolution surfaces underlying bentonitic clay palaeosols define obvious and readily observed cycle boundaries. The immediately underlying limestones typically contain abundant rhizocretions and remnants of laminated calcrete crusts are locally preserved on some upstanding hummocks. Cracks and fissures in these crusts, some penetrating the underlying limestone, are locally filled with rounded calcrete-coated grains (calcrete ooids). However, where clay palaeosols and hummocky surfaces are not developed, cycle boundaries are more difficult to recognize and the identification of some present in this section requires a diligent search for layers containing only sparse rhizocretions. Limestones throughout the Pedolau to Eglwys Siglen RIGS section contain fossil faunas typical of the late Asbian including the solitary corals *Dibunophyllum bourtonense* and *Palaeosmilia murchisoni*, and the colonial forms *Siphonodendron affine* and *S.* cf. *martini*, together with abundant species of *Syringopora*. In thin section the plates of the Asbian algae *Koninkopora inflata* can be observed.

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, 1954; Somerville et al., 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. Frequent falls in sea level (forced regressions) characterize this period of time and, as a consequence, the limestone successions on Anglesey, and elsewhere, are constructed from a series of shoaling-upwards sedimentary cycles. The tops of each cycle display features indicative of subaerial exposure, karstification and soil formation (Davies, 1991). However, the Anglesey succession accumulated at the landward margin of the platform and is unique in preserving features and deposits restricted to such a setting. Here, during periods of regression, fresh water streams flowed on to the emergent platform surface and incised deep channels. Distinctive siliciclastic facies accumulated within these channels and their margins display the effects of contemporaneous dissolution. The Pedolau to Eglwys Siglen RIGS provides exposures in typical late Asbian cycles and the range of dissolution and pedogenic phenomena developed at their boundaries. The lowest units in the section relate to, and were essential to the interpretation of features described in RIGS JRD5. Exposures in the Helaeth Sandstone were critical in developing a model for the infill of the fluvially incised channels which are a feature of the local Dinantian sequence, and unique within North Wales.

Network context of the site: 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.

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