South Wales RIGS Group Site Record
RIGS Description

SECTION A

General	South Wales
Site Name: Nant Cwm-du	**File Number:** Site_RAW_JRD_59
RIGS Number: 679	**Surveyed by:** R A Waters & J R Davies
Grid Reference: SN 8885 5108 to 8894 5104	**Date of Visit:** January 2011
RIGS Category: Scientific	**Date Registered:** **Owner:** Bwlchmawr Farm **Planning Authority:** Powys County Council
Earth Science Category: Stratigraphic, vulcanological, sedimentological	
Site Nature: Natural crags and mineral workings	**Documentation prepared by:** Jerry Davies
Unitary Authority: Powys County Council	**Documentation last revised:** 16th February 2012
OS 1:50,000 Sheet: 147	**Photographic Record:**
OS 1:25,000 Explorer Sheet: 187	
BGS 1:50,000 Sheet: 196	

RIGS Statement of Interest: This forms part of a net work of key sites in the mid to late Ordovician succession of the Llanwrtyd area of mid Wales which collectively allow the local rock succession and its record of vulcanism and deposition along the eastern margin of the Lower Palaeozoic Welsh Basin to be examined, and the principal geological events reported for this interval to be investigated.

The Nant Cwm-du section exposes a Caradoc succession of pyroclastic volcanic units interbedded with tuffaceous shelly sandstones, siltstones and mudstones that form the upper levels of the Llanwtyd Volcanic Formation. Acid ash-flow tuffs and associated tuffites were the products of the last major eruptions from the Llanwrtyd volcanic centre. The succeeding St. Cynllo's Church Formation records the late Caradoc cessation of vulcanism and the onset of graptolitic mudstone deposition, but, as shown by extensive slumping and debrite deposition, within what remained a tectonically unstable and seismically active region.

The section is particularly noteworthy, however, for the presence of a thin unit of oolitic ironstone in which concentrically laminated chamosite/berthierine ooids are beautifully preserved.

The Nant Cwm-du section is one the best and most accessible through the upper part of the Llanwrtyd Volcanic Formation and offers the opportunity to examine in detail the complex changes in environment that accompanied the mid Caradoc cessation of vulcanism in this Welsh Basin margin setting.

Geological setting/context: The site is one of several that expose key features of the stratigraphy of the Llanwrtyd Volcanic Inlier which marks the site of a deep submarine volcanic centre once located along the margin of the Lower Palaeozoic Welsh Basin. The centre was active from at least the mid Llanvirn until the mid Caradoc times during which period its erupted products comprised basaltic lavas and a spectrum of pyroclastic deposits including acid ash-flow tuffs (ignimbrites) and ash-fall tuffs. Common tuffaceous sandstones and siltstone testify to submarine reworking and redeposition of these volcanic materials in the form of turbidities. High level intrusions in the form of dolerite sills are also present.

The succession of volcanic and sedimentary Ordovician rocks that forms the inlier comprises the Llanwrtydd Volcanic Formation. Prior to the recent BGS survey of the region the only detailed study of these strata was that by Stamp and Wooldridge (1923). Early reports of the BGS findings are provided by Pratt (1994) and Cave and Rushton (1996), but it is a significantly revised stratigraphical model for the Llanwrtyd Volcanic Inlier that the most recent BGS publications present (BGS, 2005; Schofield et al., 2004).

The Nant Cwm-du section, located at the northern end of the inlier, exposes the uppermost levels of the Llanwrtyd Volcanic Formation and its transition into the succeeding St. Cynllo's Church Formation (Figure 5). The volcanic succession in this area is lower to mid Caradoc in age and is succeeded by graptolitic mudstones which in the vicinity of Nant Cwm-du contain *multidens* Biozone graptolites (Pratt, 1994; Schofield et al., 2004). The key part of the section ear-marked for RIGS designation is that exposed to the north of the stream (Figure 1). Here the well displayed and feature-forming 'Upper Acid Tuff' records the last major eruptive event of the inlier and is used to define the top of the volcanic division. However, the overlying strata, included in the St. Cynllo's Church Formation, also display beds of coarse-grained tuff and tuffaceous sediment that make it clear that volcanic activity and the reworking of its products continued after the eruption of this marker unit. The ill-sorted, upper tuff is also noteworthy for the abundant, large rip-up clasts it contains derived from the underlying mudstones (Figure 2) and that suggest emplacement at this site was in the form of a violent submarine debris flow rather than a primary pyroclastic ash-flow.

Exposed below the upper tuff is a succession of interbedded mudstones and tuffaceous sandstone and siltstones. The coarser beds, interpreted as turbidites, record the repeated failure of the unstable, ash-laden flanks of Llanwrtyd volcanic edifice and the transport of sediment in density flows to deeper settings. Calcareous sandstones with shelly fossils that include brachiopod and trilobite remains are also present and suggest that shallower parts of this edifice lay within the colonising depths of these benthos. At the base of this succession is a further debritic 'tuff' unit that displays deformed pillow-like structures consistent with dewatering and internal shearing during deposition (Figure 3).

A metre above the top of this unit is a 0.2 m-thick oolitic ironstone bed. Set in a mudstone matrix, the ooids occur both as scattered grains and concentrated in clots. Pratt (1994) discusses the features of this unit in detail and suggests a chamositic or berthierine composition. The well formed concentric layering is beautifully revealed in thin section where it observed coating rounded and irregular shaped nuclei, many of which appear to be altered pumice fragments (Figure 4). The ironstone provides evidence of unusual chemical conditions and of depositional processes associated

with a submarine volcanic centre, but which are still not well understood. Degraded trenches along the crop of the ironstone, both at the Nant Cwm-du site and on the hillside to the south, suggest it was locally worked for iron ore, although the age of these workings is unknown.

The Nant Cwm-du section provides accessible exposure of the upper part of the Llanwrtyd Volcanic Formation and allows the events and processes associated with the cessation of volcanism at the Llanwrtyd centre to be examined. It show that at this site the final phases of volcanism at the Llanwrtyd center were marked by the deposition in deep water of violent, eruption-triggered, debris flows and that, between eruptions, turbidity currents reworked and re-deposited tuffaceous sediment and shell remains derived from shallower settings. The oolitic ironstones exposed at the site, and previously worked for iron ore, testify to unusual Caradoc sea water chemistries in the vicinity of the Llanwrtyd centre and offer potential for future study both of their origin and exploitation.

References:

BRITISH GEOLOGICAL SURVEY. 2005. Builth Wells. England and Wales Sheet 196. Solid and Drift. 1:50 000. (Keyworth, Nottingham: British Geological Survey).

CAVE, R and RUSHTON, A W A. 1996. Llandeilo (ordovician) Series in the core of the Tywi anticline, Llanwrtyd, Powys, UK. *Geological Journal*, 31, 47-60.

PRATT, W T. 1994. Memoir contribution and geologicla notes and local details for parts of 1:25 000 sheets SN 84, 85 and 95 (Abergwesyn – Llanwrtyd Wells – Sugar Loaf). *British Geological Survey Technical Report* WA/94/03R.

SCHOFIELD, D I, DAVIES, J R, WATERS, R A, WILBY, P R, WILLIAMS, M and WILSON, D. 2004. Geology of the Builth Wells District – a brief explanation of the geological map. *Sheet Explanation of the British Geological Survey*. 1:50 000 Sheet 196 Builth Wells (England and Wales).

STAMP, L D A and WOOLDRIDGE, S W. 1923. The igneous and associated rocks of Llanwrtyd (Brecon). Quarterly Journal of the Geological Society of London, 79, 16-46.

SECTION B

PRACTICAL CONSIDERATIONS: Please score Accessibility and Safety Red Amber or Green			
Accessibility:			X
Comment: Readily accessed via farm tracks			
Safety:			X
Comment: Requires traversing streamside crags and excavations			
Conservation status: There are no known conservation designations of this RIGS			

OWNERSHIP/PLANNING CONTROL:

Owner/tenant: Bwlchmawr Farm

Planning Authority: Powys County Council

Planning status/constraints/opportunities:

There are no known planning constraints or opportunities

CONDITION, USE & MANAGEMENT:

Present use: Natural crags and degraded mineral workings

Site condition: Good; exposures are accessible and many of key features can be readily observed in the field.

Potential threats: None foreseen

Site Management: Periodic monitoring

SITE DEVELOPMENT:

Potential use (general):

Potential use (educational): Good site to examine the features of pyroclastic rocks

Other comments:

Photographic Record

Figure 1. View of the Nant Cwm-du section looking north-west; crags in upper part of the image are in the Upper Acid Tuff and overlook a linear trench believed to be degraded ironstone workings.

Figure 2. Crags in the ‘Upper Acid Tuff’ including large mudstone rip-up clasts, Nant Cwm-du.

Figure 3. Tuffaceous debrite/ash-flow; camera case for scale is immediately below the level of the oolitic ironstone, Nant Cwm-du.

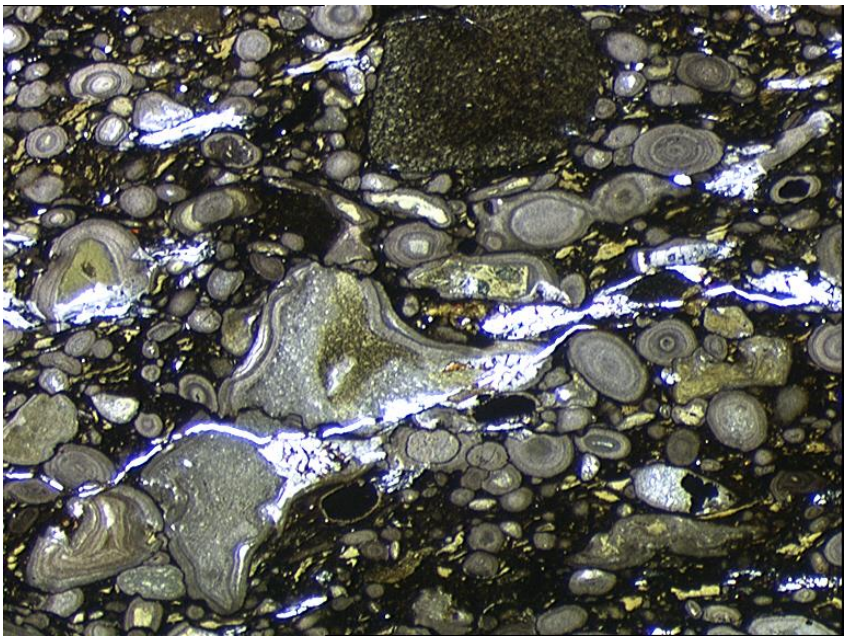

Figure 4. Thin section of Nant Cwm-du oolitic

Annotated Sketch

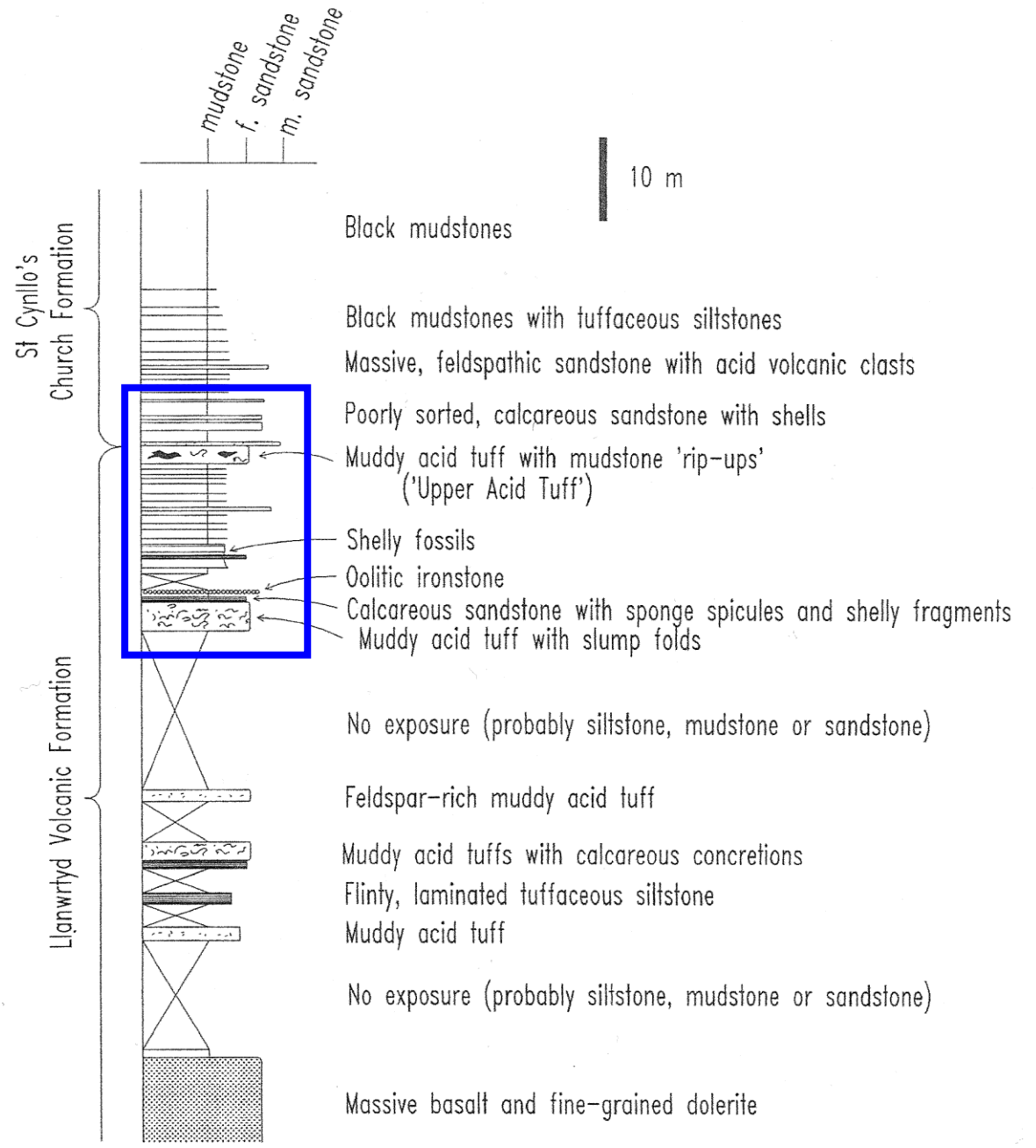

Figure 5. Log of the Nant Cwm-du section (after Pratt, 1994); the blue box indicates those parts of the section exposed on the north side of the steam that should be prioritised for conservation.