# South Wales RIGS Group Site Record
## RIGS Description

**SECTION A**

| General | South Wales |
|---|---|
| **Site Name:** Nant-gwyn quarries | **File Number:** RAW_JRD_1 |
| **RIGS Number:** 790 | **Surveyed by:** RA Waters & JR Davies |
| **Grid Reference:** SN 8764 4846 to 8780 4842 | **Date of Visit:** Jan 2011 |
| **RIGS Category:** Scientific | **Date Registered:** |
| **Earth Science Category:** Stratigraphic, Sedimentological, Palaeontological | Owner: Nant-gwyn Farm<br>Planning Authority: Powys CC |
| **Site Nature:** Disused quarry | **Documentation prepared by:** RA Waters & JR Davies |
| **Unitary Authority:** Powys County Council | **Documentation last revised:** 24th March 2012 |
| **OS 1:50,000** Sheet: 147 | **Photographic Record:** Attached |
| **OS 1:25,000** Explorer Sheet: 187 | |
| **BGS 1:50,000** Sheet: 196 (Builth Wells) | |

**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, which records 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 two quarries (west and east) at Nant-gwyn Quarry provide a unique section in the Llanwrtyd Volcanic Inlier exposing the succession of tuffites, tuffaceous sandstones and mudstones that overly the Kilsby Tuff Member of the Llanwrtyd Volcanic Formation. Planar and cross-lamination in the tuffites and sandstones is well displayed, but the western quarry is noteworthy for the well developed Chondrites burrow systems that overprint these tractional features and provide insights into complex patterns of sedimentation and colonisation of the local Ordovician sea bed.

The overlying mudstones exposed to the eastern quarry include a graptolitic level that demonstrates that the underlying Kilsby Tuff is pre-*gracilis* Biozone in age. Contrary to previously published studies this shows that the rock succession in the south of the Llanwrtyd Inlier is older than that to the north and that a major fault down-throwing to the north separates the two successions.

The Nant-gwyn quarries are unique in the potential they offers to study Ordovician sediment-faunal relationships in a deep submarine volcanic setting and in allowing the timing of key volcanic events within the Llanwrtyd Volcanic Formation to be dated. Discoveries at this site were key to a radical re-interpretation of the geological structural of the Llanwrtyd Volcanic Inlier (BGS, 2005).

**Geological setting/context**: The site is one of several that expose key features of the stratigraphy of the Llanwrtyd Volcanic Inlier. The succession of volcanic and sedimentary Ordovician rocks (Llanwrtydd Volcanic Formation) that forms the inlier ranges from Llanvirn to Cardoc in age. The western side of the inlier is faulted against Ashgill rocks, but to the east it is overlain by later graptolitic Cardoc facies that comprise the St. Cynllo's Church Formation. Prior to the recent BGS survey of the region (Schofield et al., 2004), the only detailed study of the inlier succession was that undertaken by Stamp and Wooldridge (1923). Early reports of the BGS findings, including the findings of the Nant Cerdin Borehole, were provided by Pratt (1994) and Cave and Rushton (1996), but subsequent dating at the Nant-gwyn site revealed serious flaws in these earlier syntheses and 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 Llanwrtyd Volcanic Inlier marks the site of a deep submarine volcanic centre located along the margin of the Lower Palaeozoic Welsh Basin. The erupted products of this centre included 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. During periods of volcanic quiescence the region was the site of graptolitic mudstone deposition and it is the faunas recovered from these levels that have allowed the succession to be accurately dated.

Pratt (1994) followed Stamp and Wooldridge (1923) in recognising two major ash-flow tuff units, and in viewing the tuff exposed in the Nant Cerdin valley as older than the one exposed extensively to the south in the Kilsby area. Both sets of authors assessed this southern tuff unit as lying at the top of the Llanwrtyd Inlier succession. Faunas recovered from the Nant Cerdin Borehole established that the tuff exposed in that valley, now recognised as the Nant Cerdin Tuff Member, was of Caradoc (*gracilis* Biozone) age.

The exposures afforded by the quarries at Nant-gwyn reveal an eastwards dipping and younging succession that overlies the southern tuff unit, now termed the Kilsby Tuff Member. The western quarry reveals the upper surface of the Kilsby Tuff and an overlying bedded succession of tuffaceous sandstones and siltstones (Figures 1 & 2). The eastern quarry exposes the succeeding grey and dark grey silty and sandy mudstones. The latter include disturbed and debritic units and offer local evidence of burrowing, but contain, in addition, a fossiliferous level that yields abundant graptolites (Williams, 2003). The taxa recovered included *Diplograptus foliaceus*, *Diplograptus*? cf. *decoratus*, *Hustedograptus teretiusculus*?*, Climacograptus antiquus* and *Pseudoclimacograptus modestus* are recorded. The fauna also includes orthoconic nautiloids, inarticulate brachiopods, trochospiral and high-spired gastropods, trilobites, extensive burrows and ostracods including *Schallreuteria builthensis*. These fossil remains are commonly fragmentary, but they demonstrate that rocks here are of pre-Caradoc *Glyptograptus teretiusculus* Biozone in age – they are older than the Nant Cerdin Tuff as too must be the underlying Kilsby Tuff.

These findings underpinned the re-interpretation of the local stratigraphy and structure that is presented on the recent BGS map for the region (BGS, 2005). This shows that the stratigraphy that crops out in southern portion of the Llanwrtyd

Volcanic Inlier comprises the oldest portion of Llanwrtyd Volcanic Formation and is Llanvirn in age. It is now recognised that a major WNW-ESE trending fault which downthrows to the north intervenes between the Nant-gwyn exposures and those in the Nant Cerdin valley. The volcanic succession the crops out to the north of this structure is younger, exclusively Caradoc, in age. It is clear also that since the Kilsby Tuff Member does not occupy the top of the inlier succession, as previously believed, the succession of post-volcanic Caradoc rocks (St. Cynllo's Church Formation) that occupies the ground to the east of Nant-gwyn exposures must also be downfaulted; and a major NNE-SSW trending fracture defining the south-eastern boundary of the inlier is now recognised.

In addition to their stratigraphical and structural significance, the Nant-gwyn exposures are additionally important in revealing the patterns of sedimentation and faunal colonisation that followed the major Kilsby Tuff Member eruption. Crags immediately to the north of the western quarry reveal the upper surface of this ash-flow tuff and the quarry face exposes the well-bedded succession of air-fall tuffs, tuffites, tuffaceous sandstones and siltstones that rests up on it (Figures 1 & 2). Beds which display normal grading (fining upwards) may record simple air-fall deposition, but the complex alternation of planar- and cross-laminated internal divisions in many units testifies to reworking and deposition from surging turbidity currents either during or shortly following minor pyroclastic eruptions (Figures 3 & 4). These internal patterns and divisions are particularly well seen in the abundant loose blocks on the floor of the quarry. These also reveal the re-colonisation of the sea bed by soft-bodied, burrowing organisms that followed each depositional event. Well formed *Chondrites* burrow systems are seen penetrating the top of each bed with the intensity of borrowing decreasing downwards (Figure 4). Little detailed work has been undertaken on these strata and their trace fossil suites, and on the insights they may provide about patterns and rates of faunal re-colonisation, and the frequency of turbidite/volcanic events during this post-Kilsby Tuff eruption period. Conservation of the section, including access to the loose blocks which reveal many of the internal features of these rocks, is considered important to allow more rigorous future study of these parameters.

Collectively, the quarry exposures at Nant-gwyn provide evidence of vulcanism and sedimentation in a deep marine, graptolitic setting. They offer an important opportunity to examine the flux of sedimentary and volcanic events the followed a major acid ash-flow tuff eruption and the impact these had on the faunal re-colonisation of sea bed. The site is also significant as the locality where fossil discoveries first showed that the Kilsby Tuff Member was Llanvirn in age and which, consequently, underpinned a major re-evaluation of Llantwrtyd Volcanic Inlier structure and stratigraphy.

**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.

WILLIAMS, M. 2003. Graptolites from the small quarry near Nant Gwyn, Llanwrtyd Wells, central Wales. *British Geological Survey Internal Report*, IR/00/02.

**SECTION B**

| **PRACTICAL CONSIDERATIONS**: Please score Accessibility and Safety Red Amber or Green | | | |
|---|---|---|---|
| **Accessibility**: | | | X |
| Comment: No access issues provided permission is obtained from landowner | | | |
| **Safety**: | | | X |
| Comment: The fenced-off western quarry is abandoned and can be accesses safely via stile. The ground in the quarry site is locally boggy and care needs to be taken negotiating the vegetation that has recently grown across the main quarry face. The eastern quarry is still worked periodically by the landowner for local aggregate. The faces are low and readily accessed, though care should be taken to avoid standing machinery and the site should be avoided when being actively worked. | | | |
| **Conservation status**: There are no known conservation designations of this RIGS | | | |

**OWNERSHIP/PLANNING CONTROL**:

**Owner/tenant**: Nant-gwyn Farm

**Planning Authority**: Powys County Council

**Planning status/constraints/opportunities**:

There are no known planning constraints or opportunities

**CONDITION, USE & MANAGEMENT**:

**Present use**: The western Nant-gwyn quarry is abandoned; the eastern quarry is periodically worked for local aggregate by the landowner

**Site condition**: The western quarry is extensively overgrown. Through the main face remains accessible, many of the loose blocks previously visible at the site and which revealed key features of the sedimentology are now difficult to access without excavation. The current state of exposure in the worked eastern quarry is excellent.

**Potential threats**: Unchecked growth of vegetation at the western quarry will soon obscure the exposures and piles of loose blocks, and make access to the site difficult. Ongoing excavation at the eastern quarry is currently maintaining the quality of the exposure and ensuring that new graptolitic material is revealed, but there is a risk that key parts of the face may be removed and that the site may be backfilled.

**Site Management**: Western quarry: some removal of vegetation from the main quarry face and re-excavation of the loose block piles on the quarry floor is urgently needed to restore the site, followed by periodic visits to keep the growth of vegetation at bay. Eastern quarry: regular monitoring to ensure key parts of the face are not destroyed by ongoing excavation at the site and that the site is not backfilled.

**SITE DEVELOPMENT**:

**Potential use (general)**:

**Potential use (educational)**:

**Other comments**:

## Photographic Record

Figure 1. Nant-gwyn Quarry (west) showing crags in Kilsby Tuff Member (right) overlain by well-bedded tuffs and tuffaceous sandstones in quarry face to left, Llanwrtyd Volcanic Formation.

Figure 2. Well-bedded tuffs and tuffaceous sandstones in Nant-gwyn Quarry (west), Llanwrtyd Volcanic Formation.

Figure 3. Loose block in Nant-gwyn Quarry (west) showing graded-bedding, planar- and cross-laminated tuffaceous sandstones with *Chondrites* burrows (right), Llanwrtyd Volcanic Formation

Figure 4. Loose block in Nant-gwyn Quarry (west) showing *Chondrites* burrows invading upper part of normally graded, tuffaceous sandstone bed, Llanwrtyd Volcanic Formation