
Pentraeth Road RIGS Site

NRW RIGS no. 193 [SH 52807 78456]

[GeoMôn Global Geopark original webpage](#)

RIGS Statement of Interest:

Pentraeth Road RIGS is the most accessible Precambrian age pillow lava which is partially altered to glaucophane (crossite) schist.

However, the site within a few feet of relatively busy road poses safety problems. In places the exposure exhibits the outlines of pillows, thus proving its former existence as an igneous deep sea pillow lava. In thin section some samples have yielded the mineral glaucophane which is only formed under unusually high pressure/low temperature conditions. The rock has been shown to possess the geochemistry of ocean-floor basalts and is generally considered to be its metamorphosed equivalent within the Monian Gwna Group. Historically, this site has been used by University tutors for some 60 years to demonstrate the origin of glaucophane schist. Recent, unpublished research explains its current location as part of an accretionary prism, that attached itself to the base of continental crust along a transcurrent fault. It would therefore be part of a tectonic, rather than a stratigraphic sequence. These exposures thus provide important evidence suggesting that plate tectonic processes of similar character, have been operative throughout Phanerozoic time.

Geological setting/context: The Precambrian basement rocks of Anglesey and south-west Llŷn can be divided into several discrete groups, all of which were juxtaposed along a series of steep, brittle and/or ductile faults and shear zones (e.g. Dinorwic and Aber-Dinlle faults; Berw, Central Anglesey and Llŷn shear zones) collectively referred to as the Menai Strait Fault System (MSFS). First, the Monian Supergroup consists of a thick sequence of polydeformed metasediments and meta-igneous rocks, comprising the South Stack, New Harbour and Gwna groups, the latter representing the type example of a large-scale submarine debris flow or *mélange* said by some researchers to be of Lower Cambrian age. Ongoing research, however, may suggest a much older date for the Gwna Group with possible Cambrian ages being put forward for the South Stack metasediments. Second, the Coedana Complex of central Anglesey comprises high-grade metasediments, amphibolites and gneisses, and low-grade, thermally metamorphosed hornfelses adjacent to a granite (Coedana Granite), which has recently yielded a late Precambrian zircon age of 614 ± 4 Ma. Third, a belt of schists and metabasites displaying blueschist facies grade of metamorphism lies within the MSFS. The metabasites exhibit a strong mid-ocean ridge basalt signature and have yielded ages of 580–590 Ma. Fourth, the Sarn Complex in Llŷn comprises metagabbros and granite rocks which occur to the south-east of the Llŷn Shear Zone (LSZ), a continuation of the MSFS, which separates these igneous rocks from low-grade Monian *mélange* to the north-west. A late Precambrian zircon magmatic age of 615 ± 2 Ma has been obtained from a metagabbro of the LSZ. Fifth, on the mainland of north-west Wales, the Arfon Group comprises a thick sequence of tuffs and volcanoclastic rocks, dated at 614 ± 2 Ma, which are conformably overlain by late Lower Cambrian siltstones. Correlatives of the Arfon Group may occur as isolated outliers on Anglesey and, if proven, would provide an important potential lithostratigraphical link across the MSFS. The stratigraphical correlation between the various units has proved highly controversial. The recent recognition of mylonitic rocks, for example in the LSZ, emphasises the presence of tectonic contacts and indicates that each component may represent a so-called 'suspect terrane' which was transported laterally into position along the major faults and shear zones. Ongoing unpublished research suggests, that Anglesey's Precambrian rocks accumulated in accretionary prisms, providing a tectonic sequence rather than a stratigraphic sequence which was formerly accepted. This new research would reverse the accepted stratigraphic order of the bedded succession, the South Stack Group, the New Harbour Group and the Gwna Group established for the island by Robert Shackleton. This Precambrian basement later formed the north-west margin of the Lower Palaeozoic Basin, the initiation of which was contemporaneous with Arfon basement terranes and was completed at least by early Ordovician times since an unconformable Arenig overstep sequence has been identified at several localities such as Wig Bach, Parwyd and Mountain Cottage Quarry. The Arenig sequence of Anglesey and Llŷn is considerably less deformed and metamorphosed than the underlying basement, although this

distinction is not everywhere obvious.

Network context of the site: Pentraeth Road Cutting is a critical component of a network of five RIGS which demonstrate key features of the Greenly's Precambrian Penmynydd Zone of metamorphism (more recently termed the Eastern Schist Belt by Horák and Gibbons) in Anglesey. The rock is exposed in a single outcrop which has been split in two parts by the construction of a road through the middle of the exposures. The road is the B 5109, Beaumaris to Pentraeth Section and the outcrop occurs about 200 metres south of Pentraeth cross roads at the junction of the B5109 and A 5025, Anglesey coast road. The rocks comprise fine-grained, dark spilitic lavas with occasional relict pillow forms. The geochemistry of these basic rocks shows that they were originally mid-ocean-ridge-basalt (MORB), representing a slice of Precambrian oceanic crust. The amphibole minerals are only seen in thin section in some patches which must have formed when the basalt was subducted into oceanic trenches along destructive plate margins, where 'cold' rocks were quickly buried and subjected to high pressures whilst remaining 'refrigerated' at relatively low temperatures. However, as the rocks are, in the main, spilites they cannot have sunk to the depths of the true glaucophane schists which occur in the surrounding area. They are of unknown age but the actual blueschists in nearby exposures on Mynydd Llwydiarth have been dated at 560–550 Ma. Such ages are interpreted as having been produced during rapid uplift of the blueschists during oblique movements on the MSFS. The rocks are in regional, unconformable or tectonic contact with the Gwna Group Mica Schists within Greenly's Penmynydd Zone of Metamorphism and, are interpreted as having belonged to a Precambrian accretionary prism. It is possible that all Precambrian rocks in southern Britain were part of the same Avalonian subduction system as Nova Scotia, Newfoundland and Canada. Apart from the spilite/blueschist at the proposed GCR site, Pentraeth Road Cutting, four other RIGS have been chosen for their varying importance. Llanfair P.G. represents the freshest exposures of blueschists anywhere on the island. Mynydd Llwydiarth will not be documented until the exposures can be located precisely. It is known to be important for research purposes. Castellior Farm has several outcrops in the field adjacent to the farmhouse and were said by Dennis Wood to be the best exposures in Anglesey. These rocks are also important for demonstrating that the schists were originally pillow lavas. The wall at the junction of the B5109 with the Llanddona Road in Llansadwrn shows the local use made of this attractive rock which also displays the largest crystals visible in the blue schists. The rocks beneath The Marquis of Anglesey's Column are known world-wide and are listed as a GCR site. However, the quality of the glaucophane minerals at this location is more like the Castellior Farm exposures.

To select RIGS to demonstrate the Precambrian evolution of Anglesey and Llŷn, three separate networks were devised. These are: 1. Precambrian stratigraphy and structures. This network includes two sub-sets: a) Precambrian sedimentary structures; and b) tectonic structures, such as folds and faults, which may have occurred during a tectonic event in Precambrian times or later, for example, during the Caledonian Orogeny; 2. Precambrian palaeontology which includes any life-form and trace fossil, such as stromatolites, sponge spicules, worm burrows and bioturbated metasediments. Some current research suggests that some of these fossils may be Cambrian or even Ordovician in age, although other geologists dispute this. As these life-forms were previously held to be Precambrian in age, they have been included in this category; and 3. Precambrian reference sections. These aim to represent all important Precambrian rock types found in Anglesey and Llŷn. They include the major mapped units of Greenly (1920). The aim is to provide the best and most accessible exposure of the rock type. These can be considered as RIGS 'type sections'. Where there is a relevant mineralogical, sedimentary, structural or other change across an outcrop, several representative sites have been chosen. In this study, Pentraeth Road Cutting belongs to Network 3 (RIGS Precambrian reference sections; see above) and has been chosen to demonstrate important characteristics and variations within the Eastern Schist Zone. This site is also included in the spilitic rock group as a Precambrian Reference Section but only one site report has been written for the two categories.

References:

BLAKE, J.F. (1888) On the Monian system of rocks. Quarterly Journal of the Geological Society of London, 44, 271–290.

- CARNEY, J.N., HORÁK, J.M., PHARAOH, T.C., GIBBONS, W., WILSON, D., BARCLAY, W.J., BEVINS, R.E., COPE, J.C.W. & FORD, T.D. (2000) Precambrian Rocks of England and Wales. Geological Conservation Review Series No. 20. JNCC, Peterborough, 252pp.
- FITCH, F. J., MILLER, J. A., & MENEISY, M. Y. (1963). Geochronological investigations on rocks from North Wales. *Nature*, London, 199, 449–451.
- GIBBONS, W. (1983). Stratigraphy, subduction and strike-slip faulting in the Mona Complex of North Wales – a review. *Proceedings of the Geologists' Association*, 94, 147–163.
- GIBBONS, W. & BALL, M. J. 1991. A discussion on Monian Supergroup stratigraphy in northwest Wales. *Journal of the Geological Society of London*, 148, 5–8.
- GIBBONS, W. & HORÁK, J. (1990). Contrasting metamorphic terranes in northwest Wales. In : D'LEMOIS, R. S., STRACHAN, R. A. & TOPLEY, C. G. (eds) *The Cadomian Orogeny*. Special Publication of the Geological Society of London, 51, 315–327.
- GIBBONS, W. & MANN, A. 1983. Pre-Mesozoic lawsonite in Anglesey, northern Wales; preservation of ancient blueschists. *Geology*, 11, 3–6.
- GREENLY, E. (1919). The geology of Anglesey. *Memoirs of the Geological Survey of Great Britain*. HMSO, London, 980pp. (2 vols)
- GREENLY, E. (1920). 1:50,000 (and 1 inch to 1 mile) Geological Map of Anglesey. Geological Survey of Great Britain, Special Sheet No. 92 and (93 with parts of 94, 105 and 106).
- MILLER, J. A. & FITCH, F. J. (1964). Potassium-argon methods with special reference to basic igneous rocks. *Quarterly Journal of the Geological Society of London*, 120S, 55–69.
- MOORBATH, S. & SHACKLETON, R. M. (1966) Isotopic ages from the Precambrian Mona Complex of Anglesey, North Wales (Great Britain). *Earth and Planetary Science Letters*, 1, 113–117.
- SHACKLETON, R. M. (1966). The Precambrian of North Wales. In WOOD, A. (ed.) *The Precambrian and Lower Palaeozoic rocks of Wales*. University of Wales Press, Cardiff, 1–22.
- SHACKLETON, R. M. (1975). Precambrian rocks of Wales. In: HARRIS, A. L., SHACKLETON, R. M., WATSON, J., DOWNIE, C., HARLAND, W. B. & MOORBATH, S. (eds) *Precambrian. A correlation of Precambrian rocks in the British Isles*. Geological Society Special Report 6, 76–82.
- TUCKER, R.D. & PHARAOH, T.C. (1991). U-Pb zircon ages for Late Precambrian igneous rocks in southern Britain. *Journal of the Geological Society of London*, 148, 435–443.
- WOOD, D. S. (1974). Ophiolites, melanges, blueschists and ignimbrites; early Caledonian subduction in Wales? In: DOTT, R. R. & SHAFER, R. H. (eds) *Modern and Ancient Geosynclinal Sedimentation*. Society of Economic Palaeontologists and Mineralogists, Special Publication, 19, 334–344.

Site geometry: Site boundary