
Llanfair bypass RIGS site

NRW RIGS no. 247 [SH 53257 72280]

[GeoMôn Global Geopark original webpage](#)

RIGS Statement of Interest:

Llanfair bypass RIGS site was exposed during construction of the A55 and consists of three, 20m exposures of unweathered glaucophane schist. This rare rock, originally a deep sea basalt (pillow lava), was metamorphosed at great depth below the earth's surface as it descended at a destructive plate margin, into a deep sea trench and beneath the continental crust. This put the rock under enormous pressure that converted the original mica, hornblende, olivine, augite and feldspar minerals into the rare glaucophane/crossite amphibole schists. Unusually, these minerals indicate that the rocks did not undergo significant heating at these depths and therefore provide important information about the environment in which these rocks formed. It is thought that these are the only unweathered examples in Britain.

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 $614 \pm 4\text{Ma}$. 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 580–590Ma. 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 $615 \pm 2\text{Ma}$ 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 $614 \pm 2\text{Ma}$, 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: Llanfair P.G. Bypass 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 series of roadside cuttings alongside the A55 which bypasses Llanfairpwll. The rocks comprise fine-grained, dark blue-grey schists with ice-smoothed upper surfaces. The

mineralogy includes, amphiboles, epidote, albite, chlorite and quartz. The amphiboles contain a green core of actinolite or barrosite with an outer rim of blue glaucophane. Blueschist metamorphism typically indicates intense metamorphism, producing a flat-lying foliation, isoclinal folds and a north to south trending mineral lineation. The geochemistry of these basic rocks shows that they were originally mid-ocean-ridge-basalt (MORB), representing a slice of Precambrian oceanic crust. These fresh blue, amphibole-bearing schists 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. Anglesey's blueschists are among the oldest of their type in the world. They 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 schists are in regional, unconformable or tectonic contact with the Gwna Group Mélange 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 blueschist at the proposed GCR site, Marquis of Anglesey's Column, four other RIGS have been chosen for their varying importance. These roadside exposures at Llanfair P.G. represent the freshest exposures of blueschists anywhere on the island. Mynydd Llwydiarth proposed RIGS 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 said by Dennis Wood to be the best exposures in Anglesey. 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 seen in the blue-schist, according to a group of Japanese scientists working on Anglesey in 2004.

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'LEMMOS, 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.