
Tyddyn Gyrfer RIGS

[GeoMôn Global Geopark original webpage](#)

RIGS Statement of Interest:

Tyddyn Gyrfer RIGS provides an important exposure of high grade Precambrian metamorphic rocks within the Coedana Granite complex, to the north-west of the main Coedana Granite outcrop in central Anglesey. It is selected to demonstrate facies variations (distinctive temperature and pressure conditions to which the rock was subjected during metamorphism) and its relationship to surrounding metamorphic rocks. The site is important because these rocks are uncommon in southern Britain and proof of their sedimentary origin is even rarer. The exposure comprises a gneiss which had a sedimentary origin (paragneiss) with interleaved amphibolites (indicative of highly metamorphosed rocks). The gneiss contains garnet, biotite and sillimanite crystals up to 3mm across, some of which have altered to other minerals, for example, amphiboles and chlorite. It is intruded by dykes (up to 10mm wide) and sills of plagioclase- and hornblende-bearing amphibolite exhibiting metamorphic regression (a second metamorphic event when highly metamorphosed rock is subjected to a prolonged period of less intense metamorphism).

The Coedana Granite is believed to have crystallised about 614 million years ago, having been derived from much older crustal rocks (1,330 — 1,443 Ma) that melted over 30km beneath the Earth's surface. The sedimentary rocks which became gneiss at Tyddyn Gyrfer are older than the intruding granite. Greenly (1919) interpreted these rocks as the old gneissic basement to the Monian Supergroup, and Bassett et al., 1986 referred to them, together with the hornfels and granite, as the Coedana Complex. Horak (1993) obtained a date of 1800Ma for the time that these rocks resided in the crust (pre-metamorphism) and suggests a tentative correlation with the Rosslare Complex in Ireland. She explains their current location as an 'exotic element' faulted into the Coedana Complex. This rare rock type, with its high-grade metamorphism, debatable origin and unproven age, makes this an intriguing site with important research possibilities.

Geological setting/context: The Precambrian basement rocks of Anglesey and south-west LI^W 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 LI^W 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 mélangé 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 580-590Ma.

Fourth, the Sarn Complex in LI^W comprises metagabbros and granite rocks which occur to the south-east of the LI^W Shear Zone (LSZ), a continuation of the MSFS, which separates these igneous rocks from low-grade Monian mélangé 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 established for the island. This Precambrian basement later formed the north-west margin of the Lower Palaeozoic Basin, the initiation of which was contemporaneous with Arfon Group volcanism. The timing of the inferred fault displacements has also been the subject of debate. Investigations on Llyn have demonstrated that assembly of the basement terranes 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 Llyn is considerably less deformed and metamorphosed than the underlying basement, although this distinction is not everywhere obvious.

To select RIGS to demonstrate the Precambrian evolution of Anglesey and Llyn, three separate networks have been 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. Current research suggests that some of these fossils may be Cambrian or even Ordovician in age, but 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 Llyn. 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.

Network context of the site Tyddyn Gyrfel belongs to Network 3 (Precambrian reference sections; see above) and has been chosen to demonstrate important characteristics and variations within the Coedana Granite Complex (CGC), namely, the effects of granite emplacement in a pre-existing highly metamorphosed rock, the gneiss. The CGC, which covers an area of 30km², has 5 RIGS: i) Porth Nobla shows a fine-grained granite at the western margin of the main outcrop and its associated hornfels; ii) Trwyn Cwmrwd at the eastern end of the outcrop illustrates a variation in the CGC where the rock contains sillimanite; iii) Gwalchmai at the centre of the intrusion represents a coarsely-crystalline facies; iv) Tyddyn Gyrfel shows high-grade metamorphosed gneiss; and v) Maen Gwyn Farm illustrates low-grade metamorphic hornfels.

References:

- 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.
- DAVIES, G.R., GLEDHILL, A. & HAWKESWORTH, C. (1985). Upper crustal recycling in southern Britain: evidence from Nd and Sr isotopes. *Earth and Planetary Science Letters*, 75, 1-12.
- 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).
- HORÁK, J.M. (1993). The late Precambrian Coedana and Sarn Complexes, NW Wales — a geochemical and petrological study. Unpublished PhD thesis, University of Wales.

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, 435-43.

Site geometry: Site boundary