
Bwa Du RIGS site

NRW RIGS no. 232 [SH 26045 76340]

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RIGS Statement of Interest:

The Bwa Du Fault is of regional importance as one of the best-exposed major faults on Anglesey. It is expressed as a 15m-wide gully between the ruggedly-exposed yellow quartzite of the Rhoscolyn Formation to its SE and the lower-lying cliffs of the green-grey schists of the New Harbour Formation to its NW. The fault zone has a trend of 1200 and a steep, near-vertical, dip. The complex faulting and juxtaposition of the Rhoscolyn Formation (South Stack Group) with the New Harbour Group of Precambrian rocks, together with later small-scale folds in the schist, make this an exciting research site and excellent teaching material for students.

Geological setting/context:

The Precambrian basement rocks of Anglesey and south-west Llyn 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 Llyn 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 $614 \pm 4\text{Ma}$. 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 Llyn comprises metagabbros and granite rocks which occur to the south-east of the Llyn 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 $615 \pm 2\text{Ma}$ 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 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. The Rhoscolyn Formation and the younger New Harbour Formation are part of the Mona Complex, of presumed latest Precambrian age, which forms most of the geology of Holy Island (see review by Shackleton 1969; also see map of Geological Survey of G.B. Sheet 92 & 93 and parts of sheets 94, 105 & 106). The Bwa Du Fault is one of several NW–SE trending major faults that dissect the geology of Holy Island and

was assumed by Greenly (1919, p. 171) to be an extension of the North Stack Fault, which runs from the southwest side of Holy Mountain out to sea at White Horses [SH 238 797]. However, viewed from the Bwa Du gully it is clear that these faults can only be connected with considerable curvature in strike, the North Stack Fault having a strike of 1400, that of Bwa Du 1200. The Bwa Du Fault displaces the NE–SW trending Rhoscolyn Anticline and at Bwa Du displaces the gently-dipping NW limb of that fold. The vertical junction of the Rhoscolyn Formation with the New Harbour Formation on the SE limb of that fold is exposed at the NE end of Porth y Corwgl [SH 270 748]; this junction is not substantially displaced at that locality across to the NE side of the fault and so the displacement must have a dominant dip-slip component. From the narrowing of the outcrop of the folded junction of the Rhoscolyn Formation with the New Harbour Formation on the north-eastern side of the fault, the displacement must be down on the northern side. The exact amount of that displacement is difficult to calculate, but assuming a sheet dip of 200N for the Rhoscolyn Formation/New Harbour Formation junction on the NW limb of the fold and a horizontal shift of the of at least a km, it must be more than 400m 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. 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 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.

Network context of the site: Bwa Du Fault is a critical component of a network of six RIGS which demonstrate folding, faulting and sedimentary structures in Precambrian strata. They belong to Network 1a and 1b (above). Bwa Du comprises two groups of Precambrian rocks separated by a major fault zone. The Rhoscolyn Formation (South Stack Group) and the younger New Harbour Group are part of the Mona Complex, of presumed latest Precambrian or early Cambrian age, which forms most of the geology of Holy Island (see review by Shackleton 1969; also see 1:50,000 map of Geological Survey of G.B. Sheet 92 & 93 and parts of sheets 94, 105 & 106). This fault is one of several NW–SE trending major faults that dissect the geology of Holy Island and was assumed by Greenly (1919, p. 171) to be an extension of the North Stack Fault, which runs from the southwest side of Holy Mountain out to sea at White Horses [SH 238 797]. However, viewed from the Bwa Du gully it is clear that these faults can only be connected with considerably curvature in strike, the North Stack Fault having a strike of 1400, that of Bwa Du 120°. The Bwa Du Fault displaces the NE–SW trending Rhoscolyn Anticline and at Bwa Du displaces the gently-dipping NW limb of that fold. The vertical junction of the Rhoscolyn Formation with the New Harbour Formation on the SE limb of that fold is exposed at the NE end of Porth y Corwgl [SH 270 748]; this junction is not substantially displaced at that locality across to the NE side of the fault and so the displacement must have a dominant dip-slip component. From the narrowing of the outcrop of the folded junction of the Rhoscolyn Formation with the New Harbour Group on the northeastern side of the fault, the displacement must be down on that side. The exact amount of that displacement is difficult to calculate, but assuming a sheet dip of 20°N for the Rhoscolyn Formation/New Harbour Formation junction on the NW limb of the fold and a horizontal shift of at least a km, it must be more than 400m.

References:

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