Carmel Head RIGS site

NRW RIGS no. 243 [SH 29359 92894]

GeoMôn Global Geopark original webpage

RIGS Statement of Interest:

This is the classic British locality for the Carmel Head Thrust plane, one of the best known structures in the Mona Complex of North Wales. Interpretation of the thrust, first described in detail by Greenly, has been the subject of important revision by Bates who has stressed the significance of the structure in controlling Ordovician sedimentation. The coastal section also covers some of the best exposures of gneisses in the Mona Complex (the Gader Inlier), the age and significance of which continue to excite interest and research. The Ordovician rocks beneath the Carmel Head Thrust are of unique interest in providing clear evidence for localised polyphase deformation within the Lower Palaeozoic succession in Anglesey. The Ordovician sediments have been mined for copper. Such a great variety of geological features along this short stretch of coastline makes the Carmel Head area one of the most significant and interesting sections in North Wales.

Geological setting/context: The Precambrian basement rocks of Anglesey and south-west Ll■n 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 Ll■n 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 ± 4Ma. 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 Ll■n comprises metagabbros and granite rocks which occur to the south-east of the Ll■n 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 ± 2Ma 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 volcaniclastic rocks, dated at 614 ± 2Ma, 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 Ll■n is considerably less deformed and metamorphosed than the underlying basement, although this distinction is not everywhere obvious.

Network context of the site: Carmel Head is a critical component of a network of RIGS which represent the various types of Precambrian rocks on Anglesey recognised from Greenly’s map (1919) and called for this exercise, reference sections. Two types of Precambrian rock are represented at this site, the Gader Gneiss which forms an inlier which is well exposed in the coastal cliffs at the southern end of the site. Gwna Green Schist occurs at the northern part of the site and is interesting on two accounts: firstly, it retains some of the original sedimentary features such as layering (bedding planes); and secondly, it overlies younger rocks on the Carmel Head Thrust Plane at this tectonically complicated site. The rocks beneath the thrust plane are Ordovician shales, some 450 million years old, which also crop out between the gneisses of the Gader Inlier and the schists on Carmel Head itself, and are superbly displayed in the deeply dissected coast. Of further interest is a mineralised area between the Precambrian gneiss and younger Ordovician shales. This was explored, unsuccessfully, for copper around 1850. In addition to the scientific interests, a former asbestos quarry to the north-west of Mynachdy Farm is of historic interest. The mineral chrysotile was mined as asbestos from a small pit where it occurred in conjunction with outcrops of green serpentine, ophicalcite, amphibole and dolerite. To select RIGS to demonstrate the Precambrian evolution of Anglesey and Ll■n, 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 Ll■n. 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 metamorphic, mineralogical, sedimentary, structural or other change across an outcrop, several representative sites have been chosen. In this study, Carmel Head RIGS belongs to Network 1b; a tectonic site where older rock overlies younger rock at a significant thrust plane; Network 3; the Gader Inlier is a reference section for the Gader gneiss, and the site is also important historically and for education purposes.

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