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## Castellior Farm rock RIGS site

NRW RIGS no. 148 [SH 54474 74052]

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### RIGS Statement of Interest:

This is probably one of the best examples of Precambrian age glaucophane (crossite) schist to be found anywhere in the world. Castellior Farm site is almost certainly the only known example of the pure navy blue schist which in places exhibits the outlines of pillows, thus demonstrating its former existence as an igneous under water pillow lava. The mineral glaucophane 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. Recent, unpublished research explains its current location as part of an accretionary prism, that attached itself to the base of continental crust along a transcurrent fault.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  $614 \pm 4\text{Ma}$ . 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:** Castellior Farm site 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 crags 'bosses' on private, gently undulating farmland in a relatively remote area of Llansadwrn, which lies to the east of the A5025 Trunk Road. The rocks comprise fine-grained, intensely foliated dark blue-grey schists. 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/ferro glaucophane. Deformation associated with the blueschist metamorphism has produced 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 an oceanic trench along a destructive plate margin. The 'cold' rocks oceanic 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 isotopically dated using the Ar-Ar method at 560–550 Ma. 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 belonging to the subduction system that extended from Southern Britain through maritime Canada to NE USA during the late Precambrian (Neoproterozoic), approximately 700–550 Ma. The Precambrian rocks in Southern Britain were part of the same Avalonian subduction system which extended from maritime Canada into New England. Apart from the blueschist at the proposed GCR site, Marquis of Anglesey's Column, 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 adjacent to the B5109 in Pentraeth are also important for demonstrating that the schists were originally pillow lavas. However, the quality of the glaucophane minerals at this location is less obvious than at Castellior Farm.

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, Castellior Farm 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.

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