Precambrian Palaeontology (PRE-PAL)

Block Description

Visit https://jncc.gov.uk/gcr-site-list, for more information on GCR blocks and sites
For Precambrian and Structural Geology GCR block descriptions and GCR site lists, visit https://jncc.gov.uk/gcr-blocks-precambrian-and-structural-geology

Introduction

In contrast to the manner in which most invertebrate fossils are represented in the GCR, fossils of vertebrates, arthropods (except trilobites) and terrestrial plants, and rare, enigmatic Precambrian fossil impressions, referred to the world-famous Ediacaran faunal assemblage do have their own dedicated GCR Blocks, because of the relative rarity of the fossil material. The GCR sites selected for Precambian Palaeontology GCR Block represent the British fossil record up to the beginning of the Palaeozoic Era, which began about 543 million years ago (Ma). 'Precambrian' is a broadly used term for rocks that pre-date the Cambrian Period, i.e. were formed before the Phanerozoic Eon. It encompasses such a vast span of time, extending back to at least 4000 Ma, and has been subdivided into two Eons, the Archaean and the younger Proterozoic Eon. The fossiliferous Precambrian rocks selected for this block belong to the latter, specifically to its youngest part, which has been given the chronological term 'Neoproterozoic'.

In British rocks, the beginning of Cambrian time is commonly marked by a widespread unconformity, and also marked by what is often considered to be the onset of the appearance of small shelly fossils, which here therefore marks the end of the 'Neoproterozoic'.

Palaeontological characteristics

Palaeontologists had long been perplexed by the major faunal break at the base of the Cambrian Period, and the Precambrian rocks below were regarded as non-fossiliferous. There was, however, a general recognition that the early Cambrian faunas which are very diverse and of sudden and cosmopolitan appearance, must have had Precambrian ancestors. There were undoubtedly large areas of late Precambrian sedimentary rocks that appeared to have suffered no high degree of subsequent metamorphism, but they proved to be always unfossiliferous. The first Precambrian fossils to gain credence as truly organic in origin were stromatolites, now recognized as structures produced by cyanobacteria (blue-green algae). These were found in considerable numbers in the Proterozoic rocks of the Canadian Shield and subsequently in other areas of the world, but there was little if any trace of remains that could be ascribed to animals. In fact when the first Precambrian animal fossils were found, they were initially dismissed as pseudofossils by most palaeontologists.

The most widely known Precambrian animal fossils are those that later came to be known as constituting the original Ediacaran Fauna. The first fossils were found in the Ediacara Hills in the Flinders Ranges of South Australia.

One of the next areas to yield Precambrian fossils was Charnwood Forest, Leicestershire, where a frondose impression was discovered in 1957. Precambrian rocks of other areas of the world also began to yield fossils and faunas were recorded from Sweden, the Ukraine, Siberia and Newfoundland. Faunas discovered in the White Sea area of northern Russia included several species in common with Ediacara. The discovery of an Ediacaran fauna in South Wales appears to be unique in that it was the Ediacaran fossils that proved the Precambrian age of the rocks, which had been mapped by the Geological Survey as of early Ordovician age.

By the late 1970s knowledge of Ediacaran faunas was extensive and with it came recognition that this was a cosmopolitan fauna that had existed shortly before the 'Cambrian explosion'. No biozones have been erected for these fossils, although there appear to be some differences between the 'early' faunas of Wales and Newfoundland, and the 'late' faunas of the White Sea and Ediacara which contain a greater diversity of forms. Differences between the Charnwood Forest Precambrian faunas and those found worldwide are discussed later in this chapter. With the renewed interest in early Cambrian fossils there arose the question of the relationship between Ediacaran animals and Cambrian forms. The Ediacaran fauna can be regarded as a sample of Neoproterozoic biodiversity. Despite this

extension of Ediacaran faunas into the Cambrian (e.g. the Burgess Shale), it is not always possible to construct evolutionary paths, linking them to Cambrian organisms.

Examination of the organizational level of the Ediacaran fauna leaves no doubts that there must have been earlier animals. Reliable dates of the Ediacaran faunas are few, but include 565 ± 3 Ma (Benus 1988) from Newfoundland down to younger than 543 ± 1 Ma from southern Namibia. We thus have a range of some 22 Ma virtually up to the base of the Cambrian, with the more complex Ediacaran assemblages believed to all lie close to the latter date. Several earlier Precambrian animal fossils have been occasionally recorded from various localities world-wide, but on investigation these have thus far mainly proved to be either incorrectly dated animal remains, or to be inorganic. However, predictions of the divergence of animal phyla based on the evidence of molecular work (e.g. Knoll, 1994) suggest that this may date back to 1000 Ma. This date is appropriate too, as it coincides with a decline in stromatolite diversity that is widely attributed to the effects of extensive metazoan grazing

Palaeogeography

The different depositional environments that developed in Britain during Precambrian times are summarised on **Precambrian of England & Wales (PRE-EG-WL)**

GCR site selection

All of the Precambrian fossils known from England and Wales are from the upper part of the Neoproterozoic. When one considers the scale of the outcrops of the Precambrian rocks of England and Wales and the generally poor exposure of the rocks in inland outcrop, it is perhaps remarkable that three areas have yielded Precambrian fossils, and these from both shallow- and deep-water environments.