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## South Stack

[SH 203 823]

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### Introduction

The cliffs around South Stack lighthouse (Figure 7.10) display some of the most magnificent exposures of folded metasedimentary rocks in Britain. In the original Memoir of the Geological Survey, Edward Greenly (1919) described these exposures as an 'amazing revelation', and the site has since become justifiably popular as a readily accessible location to view spectacular fold structures. Apart from its purely aesthetic appeal, South Stack is the type locality of the South Stack Group. In this basal unit of the Monian Supergroup, arguments over its age have centred in part on the supposed presence of *Skolithos* worm burrows at this locality (Greenly, 1919; Barber and Max, 1979). The site has also been a key component of stratigraphical, structural and sedimentological studies published by Greenly (1919), Shackleton (1954, 1969) and Phillips (1991a,b).

### Description

The site exposes a sequence of well-bedded but deformed and metamorphosed clastic sedimentary rocks (quartzite, sandstone, siltstone and mudstone) belonging to the lower part of the South Stack Group. The western part of the site, the lighthouse-capped sea stack of South Stack itself, is the type locality for the group (Figure 7.11). Phillips (1991a) has proposed that this lowest part of the South Stack Group should be referred to as the South Stack Formation. Above this unit, the eastern part of the site contains more massive, white quartzite, which forms the western edge of the outcrop of a unit referred to as the Holyhead Quartzite (Greenly, 1919; Shackleton, 1954, 1969) or Holyhead Formation (Phillips, 1991a). The sedimentary rocks have been deformed into a series of upright to SE-verging folds with gentle plunging axes. These structures are best preserved on the cliffs beneath the lighthouse and on the mainland opposite; particularly impressive fold cascades in these cliffs may be viewed from the path leading down to the lighthouse. These exposures are commonly used as a field teaching laboratory. They are impressive in themselves, but they also demonstrate: how parasitic folds develop on the limbs of larger structures, how axial planar cleavage develops in association with folds, and how such cleavage refracts through alternating competent and incompetent layers. Furthermore, the exposures offer a graphic illustration of how planar structures, such as bedding and cleavage, may be distinguished from linear structures, such as fold axes and mullions.

In addition to the more obvious structural importance, the sedimentology of the South Stack Group exposures at this site is of considerable interest. Examples of graded bedding in turbiditic greywackes are visible in the cliffside along the path to the lighthouse. At the clifftop north of the lighthouse, Greenly (1919) and Barber and Max (1979) have recorded vertical *Skolithos* worm burrows. Other sedimentary structures include sole structures, cross-lamination and climbing ripple cross-lamination, convolute lamination and water escape structures. The site is a good example of how such sedimentary structures can be well preserved in turbidite sequences despite the effects of folding, cleavage-formation, and a pervasive low-grade (lower greenschist) metamorphic overprint.

### Interpretation

South Stack has played a key role in the interpretation of Anglesey geology. It was here that Shackleton (1954) first illustrated the critical importance of using way-up structures to interpret stratigraphical sequences, and in doing so proved that Greenly's (1919) original interpretation of these rocks as being overturned was in fact incorrect. Despite the excellent exposure, however, the exact age of the South Stack Group remains uncertain. Traditionally the rocks have been considered to be Precambrian, although the claim that *Skolithos* is present in the sedimentary strata has been used to support interpretation of these as Cambrian in age (Barber and Max, 1979). More recent support for such an interpretation

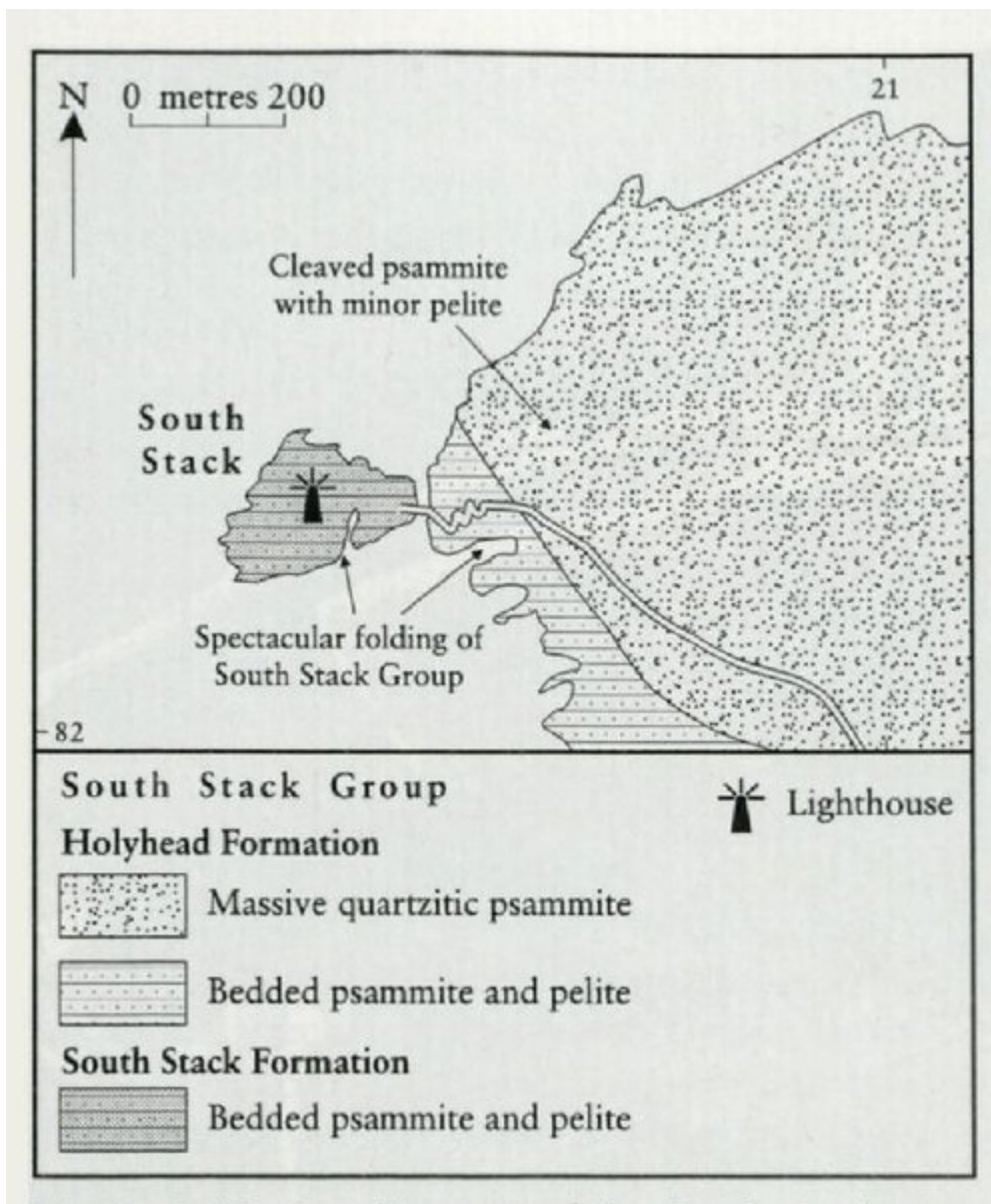
has come from comparisons with lithologically similar Palaeozoic rocks in south-east Ireland (Crimes and Dhonau, 1967; Tietzsch-Tyler and Phillips, 1989; Phillips, 1991a; Gibbons *et al.*, 1994).

The sedimentation of the South Stack Group has been broadly compared with that typical of trench, or trench-slope, settings in modern subduction systems (Wood, 1969). Many sedimentary structures described within strata at this site have been attributed to the classical Bouma turbidite sequences. In the depositional model of Phillips (1991a), the Holyhead Formation, with both channel and interchannel turbidite fan associations represented, was interpreted to have formed in the middle to inner part of a submarine fan complex. The high proportion of arenaceous material within the South Stack Formation was viewed as recording a well-developed outer-fan system of laterally coalesced and vertically stacked fan lobes (Phillips, 1991a). Sedimentary petrographical data indicate that the South Stack sediments had a continental provenance, although this source area remains as yet unidentified.

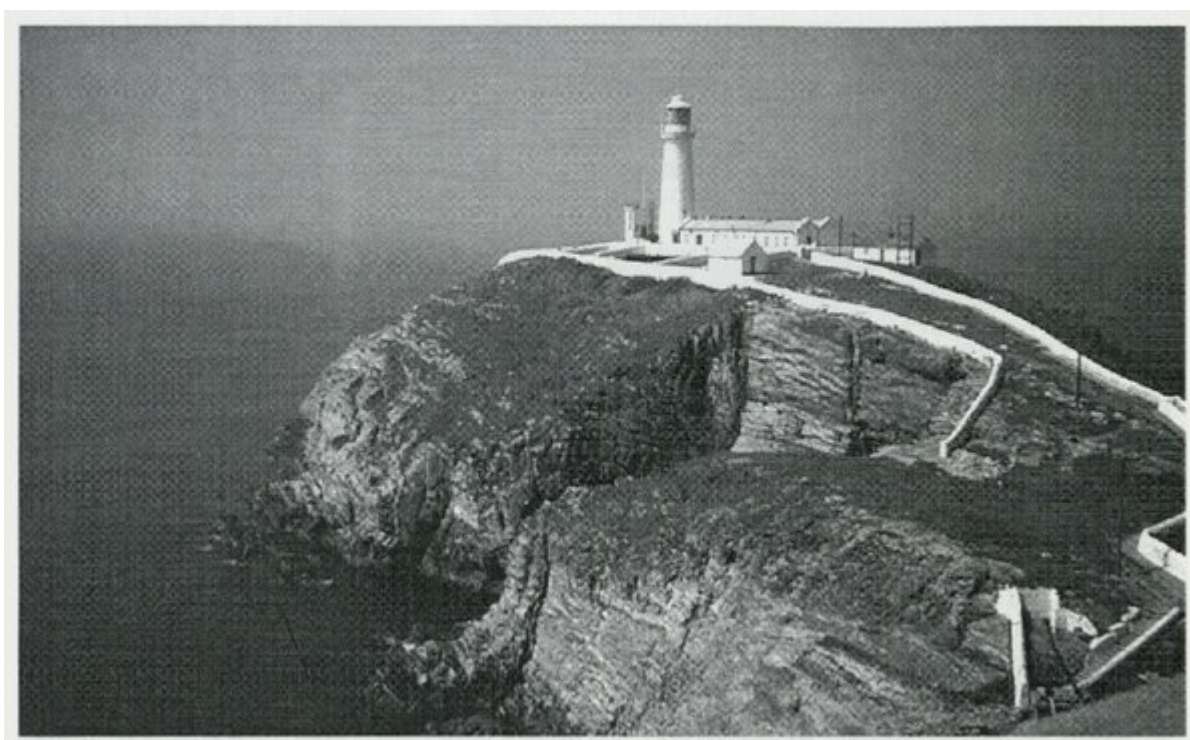
## **Conclusions**

The exposures of folded metasedimentary rocks in the cliffs around South Stack provide one of the most graphic and memorable geological localities in Great Britain. This is certainly the most easily accessible and safe place to view such rocks in Anglesey. It is the type locality for the South Stack Group, which contains trace fossils supposed to be *Skolithos* worm burrows. The site reveals excellent examples both of sedimentary structures produced by turbidite deposition in a submarine fan environment, as well as tectonic structures produced by regional compression of a sequence of marine clastic sediments. It is an excellent place to study folding and cleavage formation, and to gain an impression of how the Earth's crust can be deformed during tectonism. From a historical perspective, it was here that Robert Shackleton effected a major revision of Edward Greenly's original interpretation of Anglesey geology, and the locality has remained a focus of interest over later discussions concerning the Precambrian versus Cambrian age of the South Stack Group.

## **[References](#)**



(Figure 7.10) Locality map of the South Stack site. After Greenly (1919) and Phillips (1991b).



*(Figure 7.11) South Stack lighthouse built on folded psammites belonging to the South Stack Group. (Photo: W. Gibbons.)*