Heol Senni Quarry, Powys

[SN 915 221]

W.J. Barclay

Introduction

Heol Senni Quarry lies on the north-east face of Fan Bwlch Chwyth (Figure 5.23), Powys, 1.8 km south-west of the village of Heol Senni. The quarry provides a fine section of the Lower Devonian Senni Formation, exposing about 40 m of a succession dominated by grey-green sandstones (Figure 5.24). In addition to the site's lithological and sedimentological value, it is the type locality of *Althaspis senniensis,* which is known only from this site, providing unique dating evidence of the Senni Formation. A wide range of fossil plant remains and miospores adds to the site's importance.

Description

The quarry was first described by Edwards *et al.* (1978) for a field guide produced for a symposium on the Devonian System. These authors summarized the lithologies, palaeobotany and palynology. During the symposium field visit to the quarry, fossil fish remains (*Althaspis senniensis*)were discovered (Loeffler and Thomas, 1980). Almond *et al.* (1993) gave a brief description of the quarry. The site's importance as a fossil fish locality is detailed in the GCR fossil fishes volume (Dineley and Metcalf, 1999).

The succession comprises grey-green sandstones, with minor siltstones, mudstones and intraformational conglomerates. The beds dip generally about 5° to the SSW. A NW-trending fault, which throws down to the west, cuts the south-east corner of the quarry, producing a steeper (*c.* 25°) south-west dip in its footwall, with dips of 5° in a minor hanging-wall anticline. There is no obvious cyclicity to the arrangement of the facies. The sandstones are fine- to medium-grained, lithic arenites and are generally massive, but have low-angle cross-bedding and parallel lamination. The latter is defined by grain size, and mica and carbonaceous concentrations. Some large-scale planar and trough cross-bedding is also evident. The finer-grained sandstones are ripple cross-laminated and linguoid ripple marks are present on some bedding surfaces. The sandbodies overlie erosion surfaces, with lenses of intraformational conglomerates at their base. The conglomerates, most of which are calcitic, contain grey-green siltstone intraclasts up to 450 mm in length and rolled calcrete nodules. No exotic pebbles are recorded. Some sandstone beds are rich in mica and show primary current lineation. Shredded plant debris is also common. Soft-sediment deformation structures are prominent and include a laterally persistent ball-and-pillow unit and large-scale slump folds. The thin mudstone interbeds are mostly grey-green and blue-grey, but red-brown siltstones, some containing calcrete nodules, are present towards the top of the exposed succession. Some of the mudstones have sandstone-filled desiccation cracks.

The quarry is one of only four localities to have yielded fossil fish remains in the Senni Formation discovered to date. The species (*Althaspis senniensis*)is unique to this site (Loeffler and Thomas, 1980; Dineley, 19990. The other three localities are Primrose Hill Quarry Crickhowell (White, 1938; Barclay, 1989), which yielded *Rhinopteraspis dunensis* (= *cornubica*), Ferryside, Carmarthenshire, which yielded *Pteraspis dixoni* and *Cephalaspis* sp., and Allt ddu, Brecon [SO 027 242], which yielded *Protopteraspis gosseleti* (Habgood, 2000; Edwards and Richardson, 2004). Dineley (1999f) gave a detailed account of the faunal significance of the Heol Senni site and it is not repeated here.

Plant fragments are common (Edwards *et al.,* 1978). Vascular plant axes several centimetres long, cf. *Sawdonia* and cf. *Cooksonia* are recorded. Edwards *et al.* (1978) recorded well-preserved miospore assemblages from blue-grey siltstone beds. One assemblage from a fissile bed near the top of the succession contains large numbers of distally sculptured *Emphanisporites* specimens and numerous examples of *Apiculiretusispora.* Thomas (1978) recognized over fifty taxa of dispersed miospores. The important constituents of the assemblages are listed by Edwards *et al.* (*1978*).

Interpretation

Loeffler and Thomas (1980) provided the most detailed interpretation of the sedimentary environments of the Senni Formation (cf. Thomas, 1978). Allen (1974a, 1979) provided a general overview. Loeffler and Thomas (1980) interpreted the deposits as those of a comparatively high-discharge, mixed bedload, sand-dominated, braided stream complex in a medial alluvial setting. Marginal ponds on the river floodplains allowed colonization by land plants. Although most of the succession comprises in-channel sandbodies, overbank siltstones and mudstones are preserved as thin drapes and interbeds. Relatively high sedimentation rates and water-table levels during accumulation are indicated by the combination of the vertical succession of lithofacies units, the prevalence of grey-green beds, the suites of stratification types and other sedimentary structures, and the preservation of the vascular plant remains and miospores.

The in-channel facies recognized include channel lags, channel-fill deposits, units formed by the migration of linguoid, transverse, lateral and rhomboid mid-channel bars and low-amplitude sand waves, bar delta wedges and bar top sequences. Thick, multi-storey sand-bodies containing interbeds and/or lenses of intraformational conglomerate that overlie basal erosion surfaces imply repeated channel superposition, filling and excavation. Many channel units are draped by thin mudstones deposited from suspension during waning flood stages. Local, rapid, channel shifting and complete or partial channel abandonment was common. Ponding of flood waters occurred in channel cutoffs and (between stages) in parts of the secondary and tertiary distributaries of the active channel network. This local ponding, combined with decomposition of plant material (with the subsequent lowering of redox potentials), and the presence of reworked calcrete glaebules and calcitized plant fragments, giving high pH and bicarbonate ion concentrations, resulted in the calcification of many channel-lag intraformational conglomerates.

The extra-channel and floodplain sediments comprise proximal and distal crevasse-splay deposits, some possible levee sediments, and thin, fine-grained, fluvio-lacustrine units laid down in temporary floodplain lakes. Sandstones interbedded with these mudstone-dominated fluvio-lacustrine units are interpreted as incursions of crevasse-splay sands deposited during river-avulsion episodes. The Heol Senni pteraspid may well have been carried from its habitat in the main channel system and deposited within a floodplain lake or channel-fill mud unit during one such flood event. Strongly reducing post-depositional conditions are indicated for most of the fluvio-lacustrine sediments by their typically blue-grey to grey-green colour, and the preservation within them of pyrite nodules, macroplant cuticles and miospores.

Vascular plants flourished along the shores of temporary lakes, and colonized abandoned channel-fills and near-channel overbank deposits. High sedimentation rates and water-table levels, and post-burial reducing conditions resulted in a high preservation potential for the plants.

In the Brecon Beacons the Senni Formation–Brownstones Formation boundary has been drawn at the junction between the predominantly grey-green sequence and the overlying red-brown succession, even though there are apparently no major sedimentological differences between the lithofacies immediately below and above the colour change. The facies also inter-finger locally (Barclay, 1989) and Owen and Hawley (2000) note a similar interfingering of green and red facies in the underlying St Maughans Formation. However, the Brownstones higher in the succession were laid down by sandy braided streams of a more shallow and ephemeral nature than those which deposited the sediments of the Senni Formation (Tunbridge, 1981a).

The Senni Formation is the lithostratigraphical and chronostratigraphical equivalent of the lower and middle portions of the 560–600 m-thick Mill Bay Formation of the Cosheston Group of south-west Wales, which Thomas (1978; Loeffler and Thomas, 1980) and Wellman *et al.* (1998) interpreted as the deposits of a braided–meandering river system. Owen (1995) proposed a similar interpretation for the Senni Formation of the Llansteffan peninsula, suggesting low-sinuosity channels with seasonal flow in a seasonally wet, semi-arid climate.

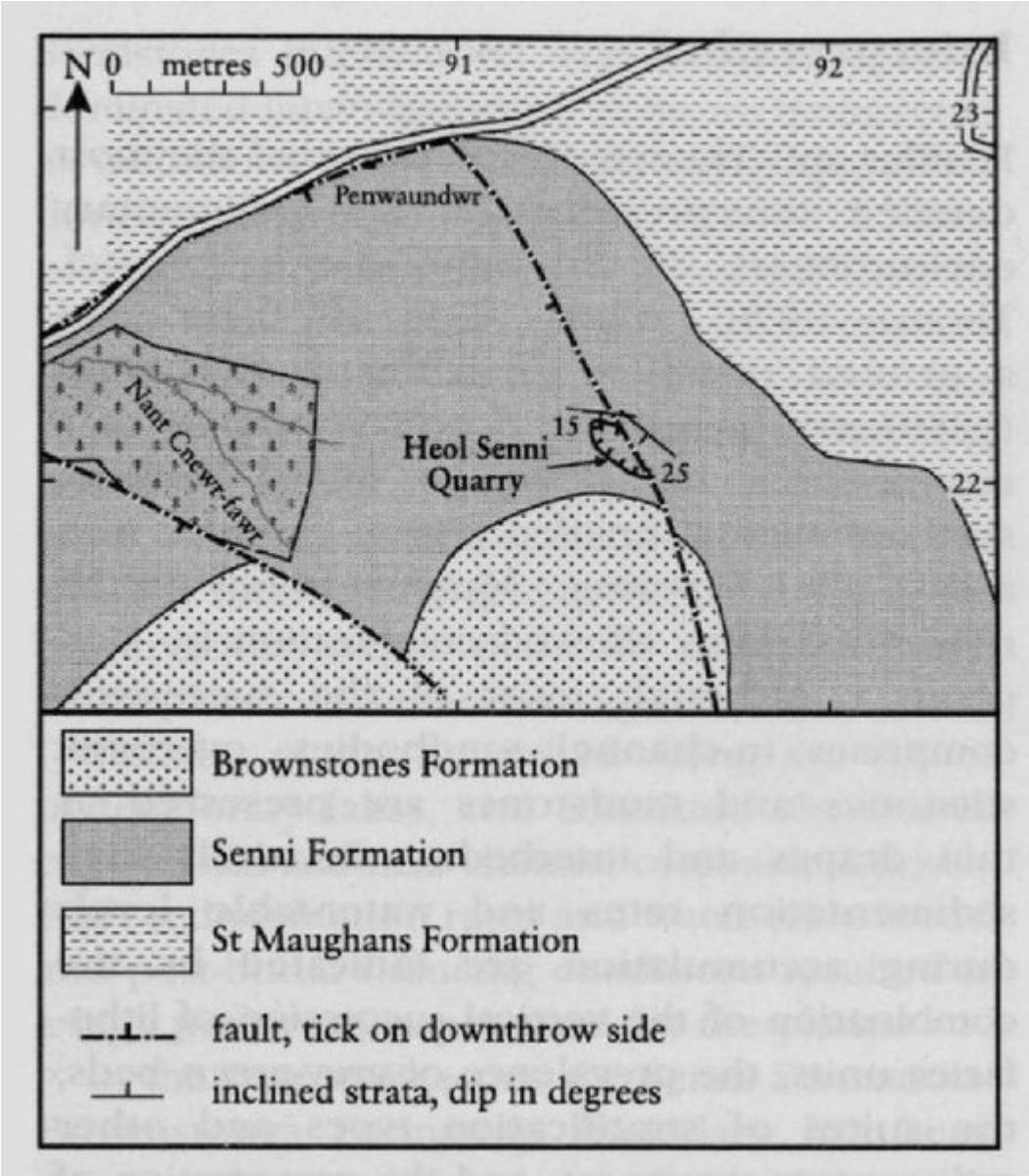
Loeffler and Thomas (1980) and Dineley (19991) provided the most comprehensive stratigraphical reviews. The palynomorphs indicate a late Lochkovian to Pragian age and the pteraspid *Althaspis senniensis* is a late Dittonian to Breconian form. The Primrose Hill pteraspid *Rhinopteraspis dunensis* occurs in the type area of the Siegenian (Pragian) stage. This, combined with the Heol Senni pteraspid and the palynomorphs, indicates that the Lochkovian–Pragian boundary lies within the Senni Formation. *Rhinopteraspis dunensis* is taken as the index fossil of the poorly defined, local

Old Red Sandstone Breconian stage.

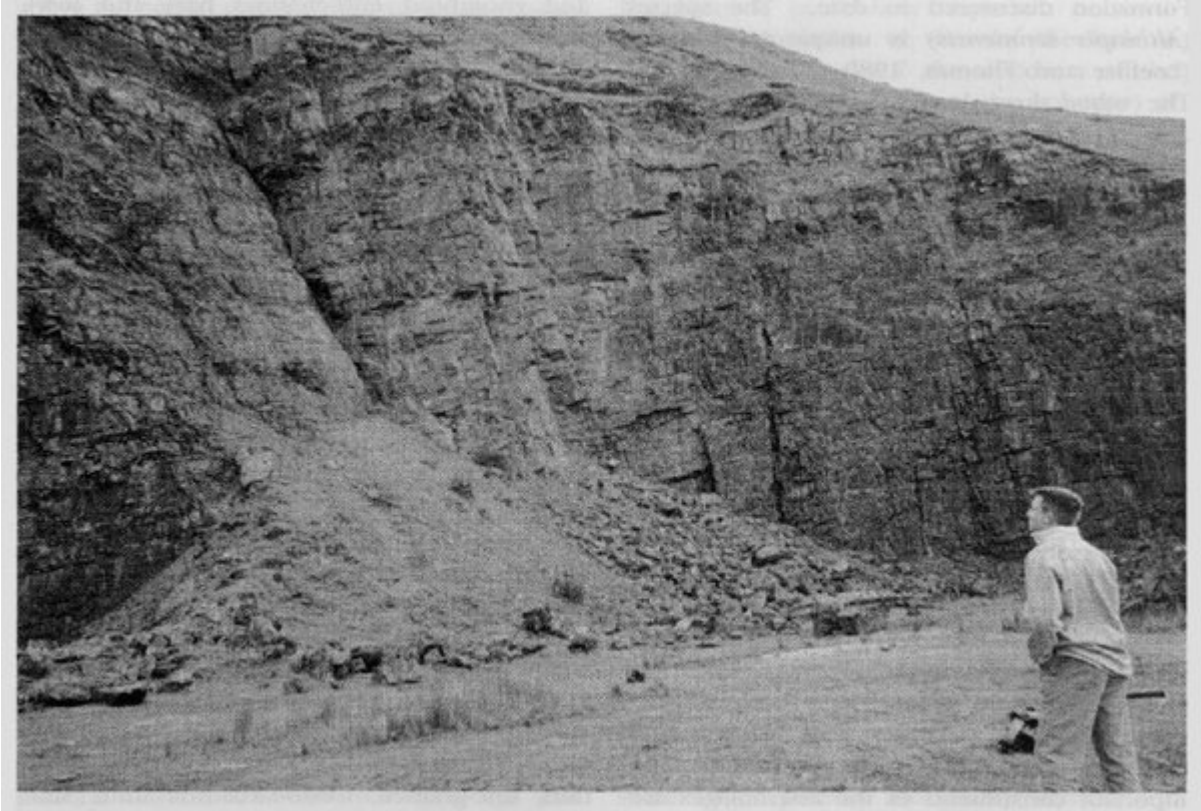
Conclusions

Heol Senni Quarry is of great importance for the sedimentological and stratigraphical information it provides. It has the thickest exposed inland vertical succession of Senni Formation in south Wales. The architecture of the stacked sand-dominated units and the relationship and types of the lithofacies present allow the anatomy of the contemporaneous floodplain and river channel environments to be modelled. Rapid sedimentation and a high water-table subsequent to burial of plant fossils provided high preservation potential and the site has yielded early vascular plant remains, as well as a rich miospore assemblage. The latter is particularly important in stratigraphical correlation in view of the lack of body fossils, except for the discovery at the quarry of the only specimen (the holotype) of the ostracoderm fish *Althaspis senniensis.* This is one of only four localities in the Senni Formation to yield fossil vertebrates, and together with its miospore assemblage, makes the site of great importance, fully justifying its protected status.

References



(Figure 5.23) Geological sketch map and location of Heol Senni Quarry. After British Geological Survey 1:50 000 Sheet 213 (England and Wales), Brecon (in press).



(Figure 5.24) View looking into the north-west corner of Heol Senni Quarry. (Photo: W.J. Barclay.)