

## The type Ludlow Series: Whitcliffe Road, Ludlow

Beds at the top of the type Ludlow Series and the local base of the overlying Prídolí Series are exposed at the junction of Whitcliffe Road and the B4361 road (formerly the A49), immediately south of Ludford Bridge. The junction, generally referred to as Ludford Corner [SO 5124 7413], is one of the classic localities of British stratigraphy. The Ludlow Bone Bed, exposed at this locality, was for a long time taken to indicate the Silurian-Devonian boundary in Britain. It is now regarded as the basal member of the Downton Castle Sandstone Formation, of Prídolí age. The section continues between 70 and 100 m westwards into Whitcliffe Road (formerly known as Ludford Lane) [SO 5116 7413]. Select '[Whitcliffe Road - vertical section](#)' to display the section, and '[Ludlow Anticline](#)' for the location of the section.

**Whitcliffe Road is a Site of Special Scientific Interest. Hammering is strictly forbidden at Ludford Corner. Collections (for research purposes only) may be obtained from the section along Whitcliffe Road ('Ludford Lane'). See Siveter *et al.* (1989) for details.**

Siveter, D.J., Owens, R.M. & Thomas, A.T. 1989. *Silurian field excursions: a geotraverse across Wales and the Welsh Borderland*. National Museum of Wales, Geological Series No. **10**, Cardiff, 133pp.

See: [Whitcliffe Road - conodonts, geochronology, lithostratigraphy, map, ostracodes, shelly faunas, spores, vertical section and fossil ranges across the Ludlow-Prídolí boundary, Ludlow Anticline.](#)

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## Whitcliffe Road - lithostratigraphy

The Upper Whitcliffe Formation, at the top of the type Ludlow succession, is overlain by the Downton Castle Sandstone Formation, of Prídolí age.

The **Upper Whitcliffe Formation** at Ludford Corner and in Whitcliffe Road comprises pale olive to light olive-grey, laminated and bioturbated calcareous siltstones, with occasional coquinas of brachiopod shells, interbedded with dark mudstones. Bedding varies from lenticular to wavy, with local developments of herring-bone cross bedding (Bassett *et al.* 1982, p. 14; Miller 1995, text-fig. 6).

The **Ludlow Bone Bed Member**, up to 0.3 m thick at the base of the **Downton Castle Sandstone Formation**, comprises ripple-laminated and lenticular bedded siltstones, containing about five, rarely but locally more, thin, brown, rippled vertebrate sands, each laterally discontinuous and only a few millimetres thick. The vertebrate sands consist mainly of thelodont scales, other ostracoderm fragments, phosphatized shell fragments, phosphatic nodules and rare quartz grains (Bassett *et al.* 1982; White & Lawson 1989). The lowest vertebrate sand (*the* Ludlow Bone Bed in the strict sense; Bassett *et al.* 1982) rests with a sharp basal contact on the Upper Whitcliffe Formation, often filling shallow scours. Bassett *et al.* (1982) concluded that there was no evidence for a major break in sedimentation, but Miller *et al.* (1997) suggested that the Ludlow-Prídolí succession at Ludlow might be incomplete, based on a comparison with successions in eastern Wales.

The Ludlow Bone Bed Member is overlain by the **Platyschisma Shale** and **Sandstone members** of the Downton Castle Sandstone Formation. The Platyschisma Shale Member, named for the characteristic mollusc *Turbocheilus* [*Platyschisma*] *helicites* (J. de C. Sowerby), comprises up to 2 m of laminated olive mudstones and siltstones with impersistent vertebrate sands. The overlying Sandstone Member consists of about 15 m of yellow, fine grained, micaceous and well sorted sandstone, with common cross bedding and channelling.

Bassett, M.G., Lawson, J.D. & White, D.E. 1982. The Downton Series as the fourth Series of the Silurian System. *Lethaia*, **15**, 1-24.

Miller, C.G. 1995. Ostracode and conodont distribution across the Ludlow/Prídolí boundary of Wales and the Welsh Borderland. *Palaeontology*, **38**, 341-384.

Miller, C.G., Sutherland, S.J.E. & Dorning, K.J. 1997. Late Silurian (Ludlow-Prídolí) microfossils and sedimentation in the Welsh Basin near Clun, Shropshire. *Geological Journal*, **32**, 69-83.

White, D.E. & Lawson, J.D. 1989. The Prídolí Series in the Welsh Borderland. In Holland, C.H. & Bassett, M.G. (eds) *A global standard for the Silurian System*. National Museum of Wales, Geological Series No. **9**, Cardiff. 131-141.

See: [Upper Whitcliffe Formation, Whitcliffe Road - vertical section and fossil ranges across the Ludlow-Prídolí boundary.](#)

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## Whitcliffe Road - geochronology

The base of the Prídolí Series was dated as 419 Ma by Tucker & McKerrow (1995), based on a U-Pb zircon age of  $420.2 \pm 3.9$  Ma (Tucker 1991) for a 0.1 m, clay-rich volcanic ash, 15 m below the top of the Upper Whitcliffe Formation at Ludford Corner.

Tucker, R.D. 1991. Ordovician and Silurian stratotypes of Britain. *In* Thermochronology: applications to tectonics, petrology and stratigraphy. Geological Society of America short course notes. *United States Geological Survey, Open-file report*, **91-565**, 57-58.

Tucker, R.D. & McKerrow, W.S. 1995. Early Paleozoic chronology: a review in light of new U-Pb zircon ages from Newfoundland and Britain. *Canadian Journal of Earth Sciences*, **32**, 368-379.

See: [Geochronology](#).

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## Whitcliffe Road - shelly faunas

Watkins (1979, fig. 16) recorded the *Protochonetes ludloviensis* Association from the Upper Whitcliffe Formation and the Ludlow Bone Bed Member of the Downton Castle Sandstone Formation in Whitcliffe Road (his section 2A, Ludford Lane). The fauna from the Ludlow Bone Bed Member was described by Watkins (1979, p. 238) as being a typical transported assemblage of the association. He noted that the *P. ludloviensis* Association completely disappeared above the Ludlow Bone Bed Member.

Bassett *et al.* (1982, p. 8, fig. 6) reported the *Protochonetes ludloviensis* Association in the Upper Whitcliffe Formation of Whitcliffe Road to be dominated by *Howellella elegans* (Muir-Wood), *Microsphaeridiorhynchus nucula* (J. de C. Sowerby), *Protochonetes ludloviensis* Muir-Wood and *Salopina lunata* (J. de C. Sowerby). *M. nucula*, *P. ludloviensis* and *S. lunata* range into, but not above the Ludlow Bone Bed Member (Bassett *et al.* 1982, fig. 6, reproduced as fig. 103 of White & Lawson 1989).

Bassett, M.G., Lawson, J.D. & White, D.E. 1982. The Downton Series as the fourth Series of the Silurian System. *Lethaia*, **15**, 1-24.

Watkins, R. 1979. Benthic community organization in the Ludlow Series of the Welsh Borderland. *Bulletin of the British Museum (Natural History)*, Geology, **31**, 175-280.

White, D.E. & Lawson, J.D. 1989. The Prídolí Series in the Welsh Borderland. In Holland, C.H. & Bassett, M.G. (eds) *A global standard for the Silurian System*. National Museum of Wales, Geological Series No. **9**, Cardiff. 131-141.

See: [Protochonetes ludloviensis Association, Whitcliffe Road - vertical section and fossil ranges across the Ludlow-Prídolí boundary.](#)

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## Whitcliffe Road - conodonts

Miller (1995) recorded conodont faunas from the top of the **Upper Whitcliffe Formation** in Whitcliffe Road (section 17a of Miller 1995, sample 77/2\*, about 0.3 m below the top of the formation) and at Ludford Corner (locality 18, sample 18/1, 0.1-0.15 m below the top of the formation). Faunas are dominated by *Coryssognathus dubius* (Rhodes) and *Ozarkodina snajdri* (Walliser), with fewer specimens of *O. remscheidensis* subspp. (notably *O. r. eosteinhornensis* (Walliser)) and *O. cf. crispa* (Walliser), the latter only in strata 0.15-0.3 m below the top of the formation. *Ozarkodina excavata* (Branson & Mehl), common at lower levels, is much less abundant in the highest 0.3 m of the formation, but *O. confluens* (Branson & Mehl) is more abundant. *Panderodus serratus* (Rexroad), recorded lower in the Upper Whitcliffe Formation, is no longer present.

Aldridge & Smith (1985, p. 37) reported the uppermost Upper Whitcliffe Formation in the vicinity of Ludford Corner to have yielded a fauna comprising *Coryssognathus dubius*, *Ozarkodina snajdri*, *O. remscheidensis eosteinhornensis*, *O. cf. crispa* and *Pelekysgnathus dubius* Jeppsson.

Miller (1995), citing earlier work (Aldridge & Smith 1985; Walliser 1966), reported fragmentary specimens of *Coryssognathus dubius*, *Ozarkodina confluens*, *O. excavata* and *O. remscheidensis eosteinhornensis* to be present in the **Ludlow Bone Bed Member**.

Aldridge, R.J. & Smith, M.P. 1985. Lower Palaeozoic succession of the Welsh Borderland. Fourth European Conodont Symposium (ECOS IV) Field Excursion B Guidebook, 39 pp.

Miller, C.G. 1995. Ostracode and conodont distribution across the Ludlow/Prídolí boundary of Wales and the Welsh Borderland. *Palaeontology*, **38**, 341-384.

Walliser, O.H., 1966. Die Silur-Devon Grenze. *Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen*, **125**, 235-246.

See: [Conodonts from the Upper Whitcliffe Formation, \*Ozarkodina crispa\*, \*Ozarkodina remscheidensis eosteinhornensis\*, \*Ozarkodina snajdri\*, Whitcliffe Road - vertical section and fossil ranges across the Ludlow-Prídolí boundary.](#)

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## Whitcliffe Road - ostracodes

Miller (1995, p. 349) found the **Upper Whitcliffe Formation** to have a virtually monospecific ostracode fauna in the Ludlow area, consisting of *Calcaribeyrichia torosa* (Jones). *C. torosa* occurs in the highest 0.4 m of the formation at locality 17a in Whitcliffe Road [SO 5116 7413], and in samples 17c/1 and 18/1, the latter about 0.15 m below the top of the formation, and the former within the highest metre of the formation, in Whitcliffe Road (locality 17c [SO 5118 7413]) and at Ludford Corner (locality 18 [SO 5124 7413]).

*Calcaribeyrichia torosa* persists into the **Ludlow Bone Bed Member** in the Whitcliffe Road section (Bassett *et al.* 1982, fig. 6), where a single specimen has been recorded 0.05-0.08 m above the base of the member (Miller 1995, p. 351; Miller *et al.* 1997, p. 80). The ostracode fauna of the Ludlow Bone Bed Member also includes *Cytherellina siliqua* (Jones), *Frostiella groenvalliana* Martinsson, *Londinia arisaigensis* Copeland, *L. fissurata* Shaw and *Nodibeyrichia verrucosa* Shaw, most of which occur at an equivalent level in eastern Wales, or possibly lower if there is a non-sequence between the Upper Whitcliffe and Downton Castle Sandstone formations at Ludlow (Miller *et al.* 1997). *F. groenvalliana* provides the evidence to correlate the base of the Downton Castle Sandstone Formation with the base of the Prídolí Series.

Siveter (1980, p. 53) recorded a single *Lophoctonella* juvenile, possibly representing *L. cf. scanensis*, from the top of the Upper Whitcliffe Formation in Whitcliffe Road (his locality 69).

Bassett, M.G., Lawson, J.D. & White, D.E. 1982. The Downton Series as the fourth Series of the Silurian System. *Lethaia*, **15**, 1-24.

Miller, C.G. 1995. Ostracode and conodont distribution across the Ludlow/Prídolí boundary of Wales and the Welsh Borderland. *Palaeontology*, **38**, 341-384.

Miller, C.G., Sutherland, S.J.E. & Dorning, K.J. 1997. Late Silurian (Ludlow-Prídolí) microfossils and sedimentation in the Welsh Basin near Clun, Shropshire. *Geological Journal*, **32**, 69-83.

Siveter, D.J. 1980. British Silurian Beyrichiacea (Ostracoda). *Palaeontographical Society Monograph*, London, part 1, 1-76, pls 1-27 (publ. No. 556, part of vol. 133 for 1979).

See: [Calcaribeyrichia torosa, Frostiella groenvalliana, Ludfordian ostracode faunas, Ostracodes and correlation of the base of the Prídolí Series, Whitcliffe Road - vertical section and fossil ranges across the Ludlow-Prídolí boundary.](#)

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## Whitcliffe Road - spores

A marked change and increase in the diversity of spore microfloras occurs across the base of the Downton Castle Sandstone Formation in the Ludlow area, and is seen in the vicinity of Whitcliffe Road (Richardson & Lister 1969, table 1; Bassett *et al.* 1982, table 2, reproduced as fig. 99 in White & Lawson 1989). Spores from the Upper Whitcliffe Formation, 18.8 to 6.17 m below the base of the Ludlow Bone Bed Member, comprise low diversity assemblages with a maximum of three species out of *Archaeozonotriletes chulus* var. *chulus* (Cramer) Richardson & Lister, *Retusotriletes* cf. *warringtoni* Richardson & Lister, *Retusotriletes* sp. A (of Richardson & Lister 1969) and *Stellatispora inframurinata* (Richardson & Lister) Burgess & Richardson (Bassett *et al.* 1982, table 2). The lowest spore assemblage from the Downton Castle Sandstone Formation, 0-0.1 m above the base of the Ludlow Bone Bed Member (Bassett *et al.* 1982, table 2), comprises *Apiculiretusispora spicula* Richardson & Lister, *Apiculiretusispora synorea* Richardson & Lister, *Archaeozonotriletes chulus* var. *chulus* (Cramer) Richardson & Lister, *Cymbosporites echinatus* Richardson & Lister, *Cymbosporites verrucosus* Richardson & Lister, *Laevolancis* cf. *divellomedia* (Chibrikova) Burgess & Richardson, ?*Perotriletes* sp. A (of Richardson & Lister 1969), *Retusotriletes* cf. *minor* Kedo, *Retusotriletes* sp. A (of Richardson & Lister 1969), *Stellatispora inframurinata*, *Synorisporites downtonensis* Richardson & Lister, *Synorisporites tripapillatus* Richardson & Lister and *Synorisporites verrucatus* Richardson & Lister, indicating the *Synorisporites tripapillatus*-*Apiculiretusispora spicula* Biozone. The base of the *tripapillatus*-*spicula* Biozone is placed immediately above the Ludlow Bone Bed (Richardson & McGregor 1986, p. 9; this is presumed to mean the Ludlow Bone Bed *sensu stricto*, i.e. the lowest vertebrate sand, rather than the Ludlow Bone Bed Member).

The increase in diversity is accompanied by morphological developments which include the appearance of tripapillate spores and distally sculptured (echinate, verrucate) patinate spores (Richardson & McGregor 1986, p.10; Richardson & Edwards 1989). There is also an increase in spore abundance, from 11% of the palynological assemblage 0-0.11 m above the base of the Ludlow Bone Bed Member, to 70% 1.78-1.83 m above the base of the member, accompanied by a decrease in the acritarch composition from 81% to 12% (Bassett *et al.* 1982, table 1; see also Richardson & Rasul 1990, table 1).

(continued...)

## Whitcliffe Road - spores (continued)

- Bassett, M.G., Lawson, J.D. & White, D.E. 1982. The Downton Series as the fourth Series of the Silurian System. *Lethaia*, **15**, 1-24.
- Richardson, J.B. & Edwards, D. 1989. Sporomorphs and plant megafossils. In Holland, C.H. & Bassett, M.G. (eds) *A global standard for the Silurian System*. National Museum of Wales, Geological Series No. **9**, Cardiff. 216-226.
- Richardson, J.B. & Lister, T.R. 1969. Upper Silurian and lower Devonian spore assemblages from the Welsh Borderland and south Wales. *Palaeontology*, **12**, 201-252.
- Richardson, J.B. & McGregor, D.C. 1986. *Silurian and Devonian spore zones of the Old Red Sandstone continent and adjacent areas*. Geological Survey of Canada, Bulletin **364**, 79 pp.
- Richardson, J.B. & Rasul, S.M. 1990. Palynofacies in a Late Silurian regressive sequence in the Welsh Borderland and Wales. *Journal of the Geological Society, London*, **147**, 675-686.
- White, D.E. & Lawson, J.D. 1989. The Prídolí Series in the Welsh Borderland. In Holland, C.H. & Bassett, M.G. (eds) *A global standard for the Silurian System*. National Museum of Wales, Geological Series No. **9**, Cardiff. 131-141.

See: [Palynofacies, \*Stellatispora inframurinata\* var. \*inframurinata\* Assemblage Sub-Biozone, \*Synorisporites tripapillatus\*-\*Apiculiretusispora spicula\* Assemblage Biozone, Whitcliffe Road - vertical section and fossil ranges across the Ludlow-Prídolí boundary.](#)

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