

The type Ludlow Series: Biostratigraphy - ostracodes

No standard ostracode zones have been proposed for the late Silurian, but the stratigraphical occurrence of Ludlow ostracodes has been reviewed by Siveter (1989, pp. 256-258) and is summarized here. Ostracodes are most useful for correlation in the upper Ludlow (Ludfordian) shelf facies of the Welsh Borderland. Stratigraphically important taxa also occur in Ludlow successions on the margin of the Welsh Basin (for example near Builth) and in the Lake District.

Details of some ostracode occurrences in the type area of the Ludlow Series may also be found in Siveter (1980).

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).

Siveter, D.J. 1989. Ostracodes. In Holland, C.H. & Bassett, M.G. (eds) *A global standard for the Silurian System*. National Museum of Wales, Geological Series No. 9, Cardiff. 252-264.

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Gorstian ostracode faunas

Many Wenlock ostracode species cross the Wenlock-Ludlow boundary, disappearing a little way above the base of the Ludlow. These include *Aechmina cuspidata* Jones & Holl, *Amphitoxotis repanda* Siveter, *Beyrichia clausa* Jones & Holl, *Jonesites excavata* (Jones & Holl), *Octonaria octoformis* Jones, *Primitiopsis valida* (Jones & Holl), *Sarmatotoxotis phracta* Siveter, *Sleia pauperata* (Jones), *Sleia troglodytophila* Martinsson, *Strepula concentrica* Jones & Holl, *Thlipsura corpulenta* Jones & Holl, '*Thlipsura*' *v-scripta* Jones & Holl and *Tinotoxotis velivola* Siveter (Siveter 1989, figs 165, 166).

Siveter (1978, p. 66) reported that *B. clausa*, *J. excavata*, *O. octoformis*, *P. valida*, *S. pauperata*, *S. troglodytophila*, *S. concentrica* and '*Thlipsura*' *v-scripta* formed part of the fauna from the uppermost **Lower Elton Formation** (lower Gorstian). Siveter (1980) recorded *A. repanda*, *S. phracta*, *S. pauperata*, *S. troglodytophila* and *T. velivola* from the Lower Elton Formation at his localities 59-61, all on Wenlock Edge.

Ostracodes are more sparse in the **Middle Elton and Upper Elton formations** (lower Gorstian); *A. cuspidata* and *T. corpulenta* occur throughout.

Ostracodes are also relatively sparse in the upper Gorstian (**Lower Bringewood and Upper Bringewood formations**). *Sleia ancon* Siveter and *Zorotoxotis sagera* Siveter are restricted to this level in the Abberley Hills and possibly the Wenlock area (Siveter 1980, pp. 61, 74; loc. 24 in the Abberley Hills; Lower Bringewood Formation of the Wenlock area), and *Lophoctenella* cf. *scanensis* (Kolmodin) may appear in the upper Gorstian (Upper Bringewood Formation, north Shropshire, Siveter, 1980, p. 53; Siveter 1989, fig. 167). No other taxa are shown to occur at this level on the range charts published by Siveter (1989, figs 165-167).

See '[Distribution of Ludlow ostracodes](#)' for a tabulation of species' occurrences by formation.

- Siveter, D.J. 1978. The Silurian. In Bate, R.H. & Robinson, E. (eds) *A stratigraphical index of British Ostracoda*. Seel House Press, Liverpool. 57-100.
- 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).
- Siveter, D.J. 1989. Ostracodes. In Holland, C.H. & Bassett, M.G. (eds) *A global standard for the Silurian System*. National Museum of Wales, Geological Series No. 9, Cardiff. 252-264.

See: [Distribution of Ludlow ostracodes](#), [Holostratigraphy \(correlation chart\)](#).

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Ludfordian ostracode faunas

Ostracode faunas are more diverse in the Ludfordian Stage than in the Gorstian, and include species that are important in international correlation.

See [‘Distribution of Ludlow ostracodes’ for a tabulation of species’ occurrences by formation.](#)

Lower Leintwardine Formation. A fauna with *Neobeyrichia nutans* (Kiesow) and *Hemsiella* cf. *loensis* Martinsson characterizes the Lower Leintwardine Formation and its correlatives in the Welsh Borderland (Siveter 1989, p. 256). These species are sometimes associated with *Sleia equestris* Martinsson and *Calcaribeyrichia* sp. nov. 1 (*sensu* Siveter 1989), while *Embryotoxotis convallis* Siveter occurs at about the same level (Siveter 1989, fig. 167). *Lophoctenella* cf. *scanensis* (Kolmodin) ranges through the Ludfordian Stage into the Prídolí Series.

Siveter (1980) recorded *H.* cf. *loensis* from the Lower Leintwardine Formation at Aymestrey (his locality 75; SO 423 655) and Shelderton (loc. 78; SO 417 779). He also recorded *L.* cf. *scanensis* and *S. equestris* from the Lower Leintwardine Formation at Shelderton (loc. 78), and *S. equestris* from the Lower Leintwardine Formation at Aymestrey (loc. 75). Siveter (1980) recorded *E. convallis* from the highest Lower Leintwardine Formation at an unnumbered locality [SO 4109 7543] near Leintwardine.

See: [Distribution of Ludlow ostracodes.](#)

Upper Leintwardine Formation. The Upper Leintwardine Formation contains the stratigraphically important *Neobeyrichia lauensis* (Kiesow), along with *N. confluens* Shaw and *N. scissa* Martinsson (Siveter 1978, p. 67). *Sleia equestris* Martinsson, *Calcaribeyrichia* sp. nov. 1 (*sensu* Siveter 1989) and *Embryotoxotis convallis* Siveter are shown to occur at the same level on Siveter’s (1989, fig. 167) range chart.

White & Lawson (1978) and Siveter *et al.* (1989, p. 57) indicated that *Neobeyrichia lauensis* occurred in the Upper Leintwardine Formation of the Sunnyhill track section (localities C26-C28), and at locality B38 in the Upper Leintwardine Formation of the Deer Park Road section. Holland *et al.* (1963, p. 117) noted that *Neobeyrichia lauensis* is characteristic of Upper Leintwardine faunas in the west of the type Ludlow area, and that such a development is typical of the basin facies.

Siveter (1980) recorded *Atterdagia versiculus* Siveter, *E. convallis*, *Hemsiella?* sp. A, *Lophoctenella* cf. *scanensis* (Kolmodin) and *S. equestris* from the Upper Leintwardine Formation at his localities 62-64, 66-68, 78 and 79 in the type Ludlow area, as follows.

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Ludfordian ostracode faunas (continued)

	Localities							
	62	63	64	66	67	68	78	79
<i>Atterdagia versiculus</i>	+	+	+		+	+	?	+
<i>Embryotoxotis convallis</i>	+	+	+	+		+		
<i>Hemsiella?</i> sp. A	+	+	+					
<i>Lophohtonella</i> cf. <i>scanensis</i>	+	+	+				+	
<i>Sleia equestris</i>	+	+	+			+		

Locality 62: Deer Park Road [SO 4890 7109]; **Locality 63:** Bengry Track, Aymestrey [SO 4228 6544]; **Locality 64:** The Goggin [SO 4727 7004]; **Locality 66:** Wigmore Road [SO 4930 7412]; **Locality 67:** Fiddler's Elbow [SO 4266 7586]; **Locality 68:** Trippleton Farm [SO 4145 7298]; **Locality 78:** Shelderton [SO 417 779]; **Locality 79:** Wassell Barn [SO 416 756].

See: [Deer Park Road, Distribution of Ludlow ostracodes, Sunnyhill Quarry.](#)

Lower Whitcliffe and Upper Whitcliffe formations. The Lower Whitcliffe and Upper Whitcliffe formations (upper Ludfordian) contain relatively sparse palaeocene ostracode faunas, with *Hemsiella maccoyana* (Jones), *Lophohtonella* cf. *scanensis* (Kolmodin) and the characteristic *Calcaribeyrichia torosa* (Jones). Siveter (1980, p. 53) recorded a single *Lophohtonella* juvenile, possibly representing *L.* cf. *scanensis*, from the top of the Upper Whitcliffe Formation in Whitcliffe Road (his locality 69). Siveter (1989, fig. 167) showed *Macrpsilon salterianum* (Jones) to appear in the upper part of the Ludfordian (see Siveter 1980, p. 54).

Miller (1995) reported the **Upper Whitcliffe Formation** at Ludlow to have a virtually monospecific ostracode fauna comprising *Calcaribeyrichia torosa*. The species ranges into the base of the Ludlow Bone Bed Member (Downton Castle Sandstone Formation, Pridoli Series) at Ludlow.

The ostracode fauna from the Upper Whitcliffe Formation of the Much Wenlock area is also dominated by *Calcaribeyrichia torosa*, with minor occurrences of *Hemsiella* cf. *maccoyana* and *Lophohtonella* cf. *scanensis*, and that from the Upper Whitcliffe Formation of Corve Dale contains only *C. torosa*. *Calcaribeyrichia torosa* is present, with *Hemsiella* cf. *maccoyana*, in faunas from the Upper Whitcliffe Formation of Downton, and is abundant in faunas from the Upper Ludlow Formation of the Abberley and Malvern areas. Other records are from the Upper Perton Beds of the Woolhope Inlier, and the Upper Llangibby Beds of the Usk Inlier, the highest Ludlow strata in the respective inliers. Data are from Miller (1995).

(continued...)

Ludfordian ostracode faunas (continued)

- Holland, C.H., Lawson, J.D & Walmsley, V.G. 1963. The Silurian rocks of the Ludlow district, Shropshire. *Bulletin of the British Museum (Natural History)*, Geology, **8**, 95-171, pls 1-7.
- Miller, C.G. 1995. Ostracode and conodont distribution across the Ludlow/Prídolí boundary of Wales and the Welsh Borderland. *Palaeontology*, **38**, 341-384.
- Siveter, D.J. 1978. The Silurian. In Bate, R.H. & Robinson, E. (eds) *A stratigraphical index of British Ostracoda*. Seel House Press, Liverpool. 57-100.
- 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).
- Siveter, D.J. 1989. Ostracodes. In Holland, C.H. & Bassett, M.G. (eds) *A global standard for the Silurian System*. National Museum of Wales, Geological Series No. **9**, Cardiff. 252-264.
- White, D.E. & Lawson, J.D. 1978. The stratigraphy of new sections in the Ludlow Series of the type area, Ludlow, Salop, England. *Report of the Institute of Geological Sciences*, No. **78/30**, 1-10.

See: [Distribution of Ludlow ostracodes, Holostratigraphy \(correlation chart\)](#).

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Ostracodes and correlation of the base of the Prídolí Series

Ostracodes provide evidence to correlate the base of the Prídolí Series with the British succession, based principally on the appearance of *Frostiella groenvalliana* Martinsson. The correlation is indirect because ostracode faunas from the type section for the base of the Prídolí Series in Bohemia are provincial.

Frostiella groenvalliana occurs widely. In the Baltic area, it is accompanied by graptolites that enable correlation with the type Prídolí Series. In particular, *F. groenvalliana* appears 68 m above *Monograptus parultimus* Jaeger, indicative of the basal Prídolí *parultimus* Graptolite Biozone, in the Dubovskoe Borehole of the Kaliningrad area, Estonia, and consistently appears above levels correlated with the base of the *parultimus* Biozone in Estonia, Lithuania and Poland (Miller 1995). As *F. groenvalliana* appears at the base of the Ludlow Bone Bed Member of the Downton Castle Sandstone Formation at Ludlow (Miller 1995, p. 351, text-fig. 6), it provides strong evidence for placing the base of the Prídolí Series at or below the base of that formation. Supporting evidence for placing the base of the Prídolí Series at the base of the Downton Castle Sandstone Formation, is provided by occurrences of the conodont *Ozarkodina* cf. *crispa* (Walliser) and the chitinozoan *Eisenackitina barrandei* Paris & Kríz in the Upper Whitcliffe Formation of the Ludlow type area. Both *O.* cf. *crispa* and *E. barrandei* indicate correlation of the upper part of the Upper Whitcliffe Formation with a level just below the base of the Prídolí Series at the latter's type section in Bohemia.

Ostracode species that appear with *Frostiella groenvalliana* at the base of the Downton Castle Sandstone Formation at Ludlow include *Londinia arisaigensis* Copeland, *Londinia fissurata* Shaw and *Nodibeyrichia verrucosa* Shaw. *N. verrucosa* appears at the same level as *F. groenvalliana* at Long Mountain, about 40 km NNW of Ludlow, but *Londinia arisaigensis* and *Londinia fissurata* appear slightly lower there (Miller 1995, text-fig. 12).

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

See: [Distribution of Ludlow ostracodes, *Eisenackitina barrandei* Biozone, Faunal distribution across the Ludlow-Prídolí boundary, *Frostiella groenvalliana*, Holostratigraphy \(correlation chart\), *Ozarkodina* cf. *crispa*](#)

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Stratigraphically important Ludlow ostracode species

Neobeyrichia lauensis (Kiesow)

Neobeyrichia lauensis is a characteristic species of the Upper Leintwardine fauna, and has been reported from the Upper Leintwardine Formation of the Sunnyhill track and Deer Park Road sections.

See: [Ludfordian ostracode faunas, Deer Park Road, Sunnyhill Quarry.](#)

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Calcaribeyrichia torosa (Jones)

Miller (1995) reported the Upper Whitcliffe Formation at Ludlow to have a virtually monospecific ostracode fauna of *Calcaribeyrichia torosa*, noting that the species had also been reported from the Lower Whitcliffe Formation. Ostracode faunas from the Upper Whitcliffe Formation of the Much Wenlock area are dominated by *Calcaribeyrichia torosa*, with minor occurrences of *Hemsiella* cf. *maccoyana* (Jones) and *Lophoconella* cf. *scanensis* (Kolmodin), and that from the Upper Whitcliffe Formation of Corve Dale contains only *C. torosa*. *Calcaribeyrichia torosa* is present, with *Hemsiella* cf. *maccoyana*, in faunas from the Upper Whitcliffe Formation of Downton, and is abundant in faunas from the Upper Ludlow Formation of the Abberley and Malvern areas. Other records are from the Upper Perton Beds of the Woolhope Inlier, and the Upper Llangibby Beds of the Usk Inlier. Data are from (Miller 1995).

The species ranges into the Ludlow Bone Bed Member of the Downton Castle Sandstone Formation (Prídolí Series) at Ludlow. A single specimen has been recorded 0.05-0.08 m above its base (Miller 1995; Miller *et al.* 1997).

In Wales, *Calcaribeyrichia torosa* is present in the Causemountain Formation at Long Mountain. Ostracodes are sparse below bed K, a thin bone bed in the Wallop Hall Member of the Causemountain Formation correlated with the base of the Downton Castle Sandstone Formation at Ludlow (Miller 1995, p. 373). Faunas below bed K consist predominantly of *Calcaribeyrichia torosa*, accompanied by rare specimens of *Hemsiella* cf. *maccoyana* and *Lophoconella* cf. *scanensis*. On the bedding plane surface of bed K, *Calcaribeyrichia torosa* occurs with *Frostiella groenvalliana* Martinsson, *Londinia arisaigensis* Copeland, *L. fissurata* Shaw, *Lophoconella* sp. and *Nodibeyrichia verrucosa* Shaw. Its presence with *F. groenvalliana* and *N. verrucosa* is considered to show that it ranges into the base of the Prídolí Series.

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Calcaribeyrichia torosa is present with *Hemsiella* cf. *maccoyana*, *Lophoctenella* sp., *Londinia arisaigensis*, *L. fissurata* and *Frostiella* sp. at the base of the Clun Forest Formation near Clun, close to the Ludlow-Prídolí series boundary (Miller 1995, p. 364; Miller *et al.* 1997), and occurs in the underlying upper Ludlow Cefn Einion Formation in the same area (Miller 1995, p. 367). It is also present, with *Frostiella* cf. *groenvalliana* and *Lophoctenella* cf. *scanensis*, in the upper Ludlow Cennen Formation of the Cennen Valley in south Wales (Miller 1995, pp. 367, 372).

Records from Ludlow and Long Mountain show that *Calcaribeyrichia torosa* ranges into the base of the Prídolí Series. To these might be added a record from the lowermost bed of the *Platyschisma helices* Beds (with *Hemsiella* cf. *maccoyana*, *Londinia arisaigensis* and *L. fissurata*) at Knighton (Miller 1995, p.367). Consequently, *Calcaribeyrichia torosa* cannot be regarded as being entirely diagnostic of the upper Ludlow, although it may be characteristic of upper Ludlow ostracode faunas.

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.

See: [Ludfordian ostracode faunas](#).

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***Frostiella groenvalliana* Martinsson**

Although *Frostiella groenvalliana* is generally considered to be a species of the Prídolí Series, and is used to determine the base of that series in the Welsh Borderland, it is included here because of a record from the Cennen Valley in south Wales (Squirrell & White 1978). These authors recorded *Frostiella groenvalliana* from the Cennen Formation where it is associated with a shelly fauna which they considered to indicate a late Ludfordian age, equivalent to the Upper Leintwardine and Whitcliffe formations. This would make the appearance of *Frostiella groenvalliana* earlier in south Wales than in the Welsh Borderland. Miller (1995, p. 372) has commented on this occurrence, pointing out that the specimens from the Cennen Formation are not well preserved and are almost exclusively internal moulds, whereas well-preserved external moulds are needed for positive identification. He considered it better to refer the specimens from the Cennen Formation to *Frostiella* cf. *groenvalliana*. Similar reservations about the identification of the species in this instance had been expressed earlier by Siveter (in Bassett *et al.* 1982, p.16).

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Miller (1995, p. 372) also raised the possibility that the Cennen Formation was of Prídolí rather than late Ludlow age. He concluded that it was better to regard *Frostiella groenvalliana* as being restricted to the Prídolí Series until it could be demonstrated that (i) the species really was present in the Cennen Formation and (ii) the Cennen Formation was undoubtedly of Ludlow age. *Frostiella groenvalliana* does occur in the overlying Long Quarry Formation of Prídolí age in the Cennen Valley (Miller 1995, p. 367; equivalent to the Tilestones of Squirrell & White 1978).

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.

Squirrell, H.C. & White, D.E. 1978. Stratigraphy of the Silurian and Old Red Sandstone of the Cennen Valley and adjacent areas, south-east Dyfed, Wales. *Report of the Institute of Geological Sciences*, No. **78/6**, 1-45.

See: [Ostracodes and correlation of the base of the Prídolí Series.](#)

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