

The type Ludlow Series: Goggin Road

The Goggin Road [SO 4727 7184 to SO 4765 7172] is a forestry road in Mortimer Forest, about 4.75 km WSW of Ludlow. The section exposes the lower part of the Ludlow succession, from the Lower Elton Formation to the Lower Bringewood Formation. Numbers bearing the prefix 'A' refer to localities of White & Lawson (1978). Select '[Goggin Road - vertical section](#)' to display the section, '[Goggin Road - map](#)' for a plan of the section, and '[Ludlow Anticline](#)' for the location of the section.

White & Lawson (1978) gave a total thickness of 166 m for the section, but Sutherland (1994) estimated the total thickness to be about 210 m. The latter includes 14.8 m at the base of the succession which Sutherland (1994) assigned to the Lower Elton Formation, but which White & Lawson (1978) placed in the Much Wenlock Limestone Formation. Even so there remains a discrepancy of about 30 m.

The Goggin Road section has yielded shelly faunas, graptolites and chitinozoa, and so provides evidence to link these biostratigraphically important groups. Bentonites are also present, but their stratigraphical utility has not been tested.

The Goggin Road section is a Site of Special Scientific Interest. Permission to study the section (researchers only) should be obtained from the Forestry Commission at Ludlow. Other visitors (school and undergraduate parties) are directed towards specially prepared exposures along the Wigmore Road. 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.

Sutherland, S.J.E. 1994. Ludlow chitinozoans from the type area and adjacent regions. *Palaeontographical Society Monograph*, London, 1-104, pls 1-18 (publ. No. 594, part of vol. 148 for 1994).

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: [Goggin Road - bentonites, chitinozoa, graptolites, lithostratigraphy, map, shelly faunas, vertical section, Ludlow Anticline](#).

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Goggin Road - lithostratigraphy

Beds of the Lower Elton, Middle Elton, Upper Elton and Lower Bringewood formations are exposed along the Goggin Road. Select '[Goggin Road - map](#)' and '[Goggin Road - vertical section](#)' for graphic displays.

The **Lower Elton Formation** of the Goggin Road section comprises pale olive, calcareous mudstones, silty at the base of the section, with limestone nodules and interbedded bentonites (White & Lawson 1978). White & Lawson (1978) placed the base of the formation at the base of locality A1, where mudstones predominate over nodular limestones. Sutherland (1994, p. 9) observed that this level may have been chosen because of the presence of a thin limestone band, which he surmised had been regarded by White & Lawson as the highest limestone of the Much Wenlock Limestone Formation. Based on the occurrence of the shaly unit (bed C) from Pitch Coppice Quarry, conspicuous limestones overlain by shales, and chitinozoan evidence, Sutherland (1994) argued that the base of the Lower Elton Formation (and the Ludlow Series) should be placed 14.8 m below the level chosen by White & Lawson (1978) in the Goggin Road section. White & Lawson (1978) estimated the Lower Elton Formation to be about 45 m thick; Sutherland's (1994) estimate is about 58 m.

The **Middle Elton Formation** comprises light olive-grey flaggy siltstones, interbedded with bentonites. The basal metre (mudstone at locality A7) resembles the Lower Elton Formation but is siltier and darker. The contact with Lower Elton Formation is not seen (gap in exposure between localities A6 and A7). The contact with the Upper Elton Formation is almost certainly faulted, but the highest beds of the Middle Elton Formation, seen at locality A23, include a thin bed of fine-grained sandstone and thin beds of calcareous siltstone, possibly indicative of a transition to typical Upper Elton Formation lithologies (White & Lawson 1978). White & Lawson (1978) estimated the Middle Elton Formation to be about 85 m thick. Sutherland's (1994) estimate is about 95 m.

The **Upper Elton Formation** consists of hard, light olive-grey, sandy siltstones, less flaggy than the Middle Elton Formation, interbedded with hard calcareous siltstones up to 8 cm thick. The lower part of sequence appears to be faulted out. The stratigraphical contact with the overlying Lower Bringewood Formation is transitional (White & Lawson 1978). White & Lawson (1978) considered the highest 19 m of the formation to be present. Sutherland's (1994) estimate of thickness, at about 35 m, is much greater.

(continued...)

The **Lower Bringewood Formation** comprises hard, light olive-grey, massive, calcareous siltstones, with silty limestones in the upper part. Higher beds are faulted out. At the base of the formation, there is a lithological transition, over a thickness of about 2 m, from the more flaggy siltstones with calcareous bands of the Upper Elton Formation (White & Lawson 1978). White & Lawson (1978) reported the basal 17 m of the formation to be present. Sutherland (1994) estimated the Lower Bringewood Formation to be 22 m thick in the Goggin Road section.

Sutherland, S.J.E. 1994. Ludlow chitinozoans from the type area and adjacent regions. *Palaeontographical Society Monograph*, London, 1-104, pls 1-18 (publ. No. 594, part of vol. 148 for 1994).

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: [Lower Elton Formation](#), [Middle Elton Formation](#), [Upper Elton Formation](#), [Lower Bringewood Formation](#), [Goggin road - map, vertical section](#).

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Goggin Road - shelly faunas

Shelly faunas of the *Glassia obovata* and *Mesopholidostrophia laevigata* associations occur in the Goggin Road section. Select '[Goggin Road - map](#)' and '[Goggin Road - vertical section](#)' for graphic displays. See also '[Interval between the *Glassia obovata* and *Mesopholidostrophia laevigata* associations](#)'.

Glassia obovata Association

Watkins (1979) identified the *Glassia obovata* Association in his sections 2I and 2J, both in the Middle Elton Formation; section 2I is considered to be equivalent to localities A16-A18 of White & Lawson (1978), and section 2J is believed to be equivalent to localities A12-A14.

Elements of the *G. obovata* Association occur at other levels in the Lower and Middle Elton formations. Faunas from the Lower Elton Formation at localities A1, A2 and A6 include the brachiopods *Atrypa reticularis* (Linnaeus), *Craniops implicatus* (J. de C. Sowerby), *Dalejina hybrida* (J. de C. Sowerby), *Dicoelosia biloba* (Linnaeus), *Glassia*?, *Protochonetes minimus* (J. de C. Sowerby), *Resserella*, *Skenidioides* and the trilobite *Dalmanites* (BGS records; White & Lawson 1978), all of which were listed by Watkins (1979) and Lawson & White (1989) as being characteristic of the *G. obovata* Association. In the Middle Elton Formation, faunas from localities A20 and A21 include *Dalmanites* and the brachiopods *Aegiria*, *Glassia* and *Skenidioides lewisii* (Davidson) (BGS records), possibly indicating the *G. obovata* Association. The stratigraphical occurrence of the association in the Goggin Road section may therefore extend from locality A1 in the Lower Elton Formation, to locality A18 and possibly as high as locality A21 in the Middle Elton Formation. The association may not be recognizable at each of the intervening localities, however. No characteristic taxa have been recorded from localities A3 and A4 in the Lower Elton Formation, for example, and locality A19 in the Middle Elton Formation has yielded only orthocones and graptolites.

Faunas from the lowest part of the association (localities A1-A6, Lower Elton Formation) contain strophomenid brachiopods such as *Amphistrophia funiculata* (M'Coy), *Leptaena* cf. *depressa* (J. de C. Sowerby) and *Strophonella euglypha* (Hisinger), and both solitary and tabulate corals (BGS records). These forms are not typical of the *Glassia obovata* Association, but do occur in the underlying Wenlock strata, and indicate a transitional change in the composition of the shelly fauna across the Wenlock-Ludlow boundary.

(continued...)

***Glassia obovata* Association (continued)**

- Lawson, J.D. & White, D.E. 1989. The Ludlow Series in the Ludlow area. *In* Holland, C.H. & Bassett, M.G. (eds) *A global standard for the Silurian System*. National Museum of Wales, Geological Series No. **9**, Cardiff. 73-90.
- 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. 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: [Glassia obovata Association, Goggin Road - map, vertical section.](#)

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Interval between the *Glassia obovata* and *Mesopholidostrophia laevigata* associations

A more restricted shelly fauna occurs in the upper part of the Middle Elton Formation (localities A22 and A23) and throughout the Upper Elton Formation. The brachiopod *Protochonetes minimus* (J. de C. Sowerby) is the most characteristic form, accompanied at some localities by *Aegiria grayi* (Davidson), *Lingula*, *Shagamella minor* (Salter), *Shaleria* sp. and orthocones (BGS records; White & Lawson 1978). *Aegiria* and small *Shagamella* (such as those recorded from this interval) are both considered to have had an epiplanktonic mode of life (Watkins 1979, pp. 211, 226). *Mesopholidostrophia lepisma* (J. de C. Sowerby) and *Heliolites* are present at the lowest locality in the Upper Elton Formation (A24), but are absent throughout most of the formation. *M. lepisma* reappears at locality A28, at the top of the Upper Elton Formation, and is then present throughout the overlying *Mesopholidostrophia laevigata* Association (BGS records; White & Lawson 1978).

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. 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: [Goggin Road - *Glassia obovata* Association, *Mesopholidostrophia laevigata* Association](#).

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***Mesopholidostrophia laevigata* Association**

Watkins (1979, fig. 16) placed the base of the *Mesopholidostrophia laevigata* Association at about the base of the Lower Bringewood Formation in its original stratotype (Holland *et al.* 1963, loc. 196; Watkins 1979, section 2F, SO 4873 7292), about 1.5 km NE of the Goggin Road. In the Goggin Road section, characteristic species appear over an extended interval, from the top of the Upper Elton Formation (locality A28), through the lowest 12 m of the Lower Bringewood Formation (up to locality A31). *Mesopholidostrophia lepisma* (J. de C. Sowerby) is present in faunas from locality A28 at the top of the Upper Elton Formation, and from localities A29-A31 in the Lower Bringewood Formation. *Atrypa reticularis* (Linnaeus), *Dalmanites* and bryozoans reappear at locality A29, *Amphistrophia funiculata* (M'Coy), *Leptaena* sp. and *Strophonella* sp. at locality A30, and *Leptaena* cf. *depressa* (J. de C. Sowerby) and *Strophonella euglypha* (Hisinger) at locality A31 (BGS records).

Siveter *et al.* (1989, p. 54) noted that a faunal change occurs some 12 m above locality A25 (i.e. between localities A28 and A29), involving a 'dramatic reduction in the abundance of *Pristiograptus tumescens* and the introduction of several brachiopods, especially strophomenids such as *Leptostrophia filosa*, *Leptaena depressa* and *Amphistrophia funiculata*'. The change in the shelly fauna, and particularly the introduction of the strophomenids, marks the appearance of the *Mesopholidostrophia laevigata* Association. The base of the *Mesopholidostrophia laevigata* Association is placed at the base of the Lower Bringewood Formation in the Goggin Road section.

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.

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.

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.

See: [Goggin Road - map, vertical section, *Mesopholidostrophia laevigata* Association.](#)

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Goggin Road - graptolites

Saetograptus varians varians (Wood) and *Spinograptus spinosus* (Wood), recorded from the lowest locality in the Middle Elton Formation (locality A7), indicate the ***Neodiversograptus nilssoni* Biozone** (White & Lawson 1978).

White & Lawson (1978, p. 3) noted that *Saetograptus chimaera chimaera* (Barrande), *S. chimaera semispinosus* (Elles & Wood) and *Pristiograptus dubius* (Suess) occurred 'in higher beds (locality 15 and above)' of the Middle Elton Formation; Lawson & White (1989, p. 79) considered that faunas with these taxa should be assigned to the ***Lobograptus scanicus* Biozone**, although a latest *nilssoni* Biozone age cannot be excluded on the ranges published by Rickards (1976). This evidence suggests that the *nilssoni-scanicus* biozonal boundary lies between localities A7 and A15 in the Middle Elton Formation of the Goggin Road section. Locality A19 is probably no higher than the *scanicus* Biozone, based on a BGS record of *S. chimaera* (although *S. chimaera semispinosus* ranges into the overlying *tumescens/incipiens* Biozone; Rickards 1976). Siveter *et al.* (1989, p. 54) noted that graptolites are particularly common through the Middle Elton Formation of the Goggin Road section, and indicate the *nilssoni-scanicus* biozones.

Pristiograptus tumescens (Wood) has been recorded from the Upper Elton Formation at localities A24, A25, A27(?) and A28, in monospecific graptolite faunas that indicate the ***Pristiograptus tumescens/Saetograptus incipiens* Biozone** (BGS records; Siveter *et al.* 1989, p. 54). The lowest occurrence of the species, at locality A24, is in strata between 1 and 4 m above the local (faulted) base of the Upper Elton Formation. On this evidence, the base of the *tumescens/incipiens* Biozone is placed at the base of the Upper Elton Formation, although there is a gap, estimated to be at least 20 m, between A24 and the highest determined graptolites from the underlying Middle Elton Formation, at locality A19, assigned to the *scanicus* Biozone.

Lawson, J.D. & White, D.E. 1989. The Ludlow Series in the Ludlow area. In Holland, C.H. & Bassett, M.G. (eds) *A global standard for the Silurian System*. National Museum of Wales, Geological Series No. 9, Cardiff. 73-90.

Rickards, R.B. 1976. The sequence of Silurian graptolite zones in the British Isles. *Geological Journal*, **11**, 153-188.

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.

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: [Goggin Road - map, vertical section, *Lobograptus scanicus* Biozone, *Neodiversograptus nilssoni* Biozone, *Pristiograptus tumescens/Saetograptus incipiens* Biozone](#).

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Goggin Road - chitinozoa

The bases of five chitinozoan biozones (2-6) were defined in the Goggin Road section by Sutherland (1994). The base of Biozone 4 is equivalent to the base of the *Angochitina elongata* Biozone of Verniers *et al.* (1995).

The base of **Chitinozoan Biozone 2** is located at about the base of locality A1 of White & Lawson (1978), above the disappearance of *Conochitina* sp. aff. *elegans* Eisenack in sample GR9. The biozone contains very few characteristic taxa, except for *Conochitina* sp. A of Sutherland (1994) in its lower part, and is perhaps better regarded as an interzonal interval between biozones 1 and 3.

The base of **Chitinozoan Biozone 3** is defined by the appearance of *Cingulochitina gorstyensis* Sutherland in sample GR19. Comparison of locality information (White & Lawson 1978, fig. 2; Sutherland 1994, text-fig. 6) shows the base of Biozone 3 to be at localities A10-A11 of White & Lawson. Sutherland's (1994) text-fig. 39 implies that it is at the base of the strata exposed at these localities, i.e. at the base of A10.

The base of **Chitinozoan Biozone 4**, defined by the appearance of *Angochitina elongata* Eisenack in sample GR30, lies within the Middle Elton Formation at localities A16-A18 of White & Lawson (1978). Its exact level within this interval has not been recorded.

The base of **Chitinozoan Biozone 5** is defined by the first local appearance of *Ancyrochitina ancyrea* (Eisenack) and *A. cf. primitiva* Eisenack in sample GR45 (Sutherland 1994). Sutherland (1994, p. 92) placed the base of the biozone 18.8 m below the top of the Upper Elton Formation in the Goggin Road section, but showed it to be about the middle of the formation (Sutherland 1994, text-fig. 40). White & Lawson (1978), however, estimated the Upper Elton Formation to be only 19 m thick on the Goggin Road, so there is a discrepancy in thickness estimates which makes it difficult to determine the precise position of the base of the zone in the section.

The base of **Chitinozoan Biozone 6** is placed at the first occurrence of *Gotlandochitina swifti* Sutherland in sample GR62, estimated by Sutherland (1994, p. 92) to be 8 m above the base of the Lower Bringewood Formation in the Goggin Road section. Sutherland's (1994, text-fig. 40) estimate for the thickness of the Lower Bringewood Formation on the Goggin Road, at about 20 m, is slightly more than White & Lawson's (1978) estimate of 17 m.

(continued...)

Goggin Road - chitinozoa (continued)

- Sutherland, S.J.E. 1994. Ludlow chitinozoans from the type area and adjacent regions. *Palaeontographical Society Monograph*, London, 1-104, pls 1-18 (publ. No. 594, part of vol. 148 for 1994).
- Verniers, J., Nestor, V., Paris, F., Dufka, P., Sutherland, S. & Van Grootel, G. 1995. A global Chitinozoa biozonation for the Silurian. *Geological Magazine*, **132**, 651-666.
- 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: [Angochitina elongata](#) Biozone, Chitinozoan Biozone 2, Chitinozoan Biozone 3, Chitinozoan Biozone 4, Chitinozoan Biozone 5, Chitinozoan Biozone 6, Goggin Road - map, vertical section.

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Goggin Road - bentonites

Bentonites occur in the Lower Elton Formation (localities A2, A3, A4, A5 and A6) and the Middle Elton Formation (localities A9, A12, A13, A14, A16, A17, A18 and A22) of the Goggin Road. Any possible stratigraphical significance has yet to be determined.

See: [Bentonites, Goggin Road - map, vertical section.](#)

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