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Silurian time: how much of it was Přídolí?

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Kleffner's (1989) application of graphic correlation to Silurian conodont sequences brought the issue of the length of the Přídolí to the fore. His analysis gave the Přídolí a thickness, in terms of the composite standard section, equal to the Wenlock and Ludlow combined. When Kleffner's scheme was calibrated to a radiometric scale (Fordham, 1992), the Přídolí was 10 m.y. long and there were some curious results, including a duration for the *Ozarkodina remscheidenesis* Chronozone of over 11 m.y. Kleffner's (1995) revised analysis kept the relative durations of the conodont zones largely intact, including *O. remscheidensis*. Increased graptolite data did, in fact, change estimates for the relative thicknesses of the Silurian series-though the overall effect of a thick Přídolí was maintained.

Up until recently, radiometric testing of Kleffner's scheme has been equivocal. For example, the U-Pb dates selected in Tucker & McKerrow's (1995, p. 376) review were consistent with a long, or short, Přídolí[1]. Thus, if mid- and Upper Silurian dates are plotted against Kleffner's scale, a straight line of correlation is possible (Fig. 1: if the Kalkberg date is ignored, a line can be drawn which meets the Silurian-Devonian boundary in the general vicinity of 410 Ma). New zircon dates from the Devonian (Tucker *et al.*, 1997, MS), however, appear to make application of Kleffner's scheme for chronometry untenable.

The new Devonian dates include 417.6 ±1.0 Ma for a K-bentonite from the Kalkberg Formation near Cherry Valley, New York. It appears to represent the upper *woschmidti* Zone: the bed lies well above the lowest occurrence in the sequence of *I. woschmidti* (in the underlying Coeymans Formation); and the Kalkberg is immediately overlain by units (Becraft, Alsen) of the *delta* Zone. Inclusion of this date forces rejection of at least some element in the attempted calibration of Kleffner's scheme[2]. Given that the dates appear to trend remarkably consistently with their stratigraphic position, Kleffner's scale itself would seem to be implicated -in particular, the late Ludlow and Přídolí appear to be far too long.

If Kleffner's scale is significantly nonannular, the most likely culprit is the standard reference section -in this case, the Cellon section. This choice is crucial in any graphic-correlation exercise (Fordham, 1992). For instance, if the SRS has anomalously thick intervals, the resultant overestimated taxon ranges will be retained by the composite section, and their effects will only be ameliorated, and then usually only partially, by subsequent extension of ranges from other intervals preserved in other sections. Moreover, these later compiled sections will need to cover a stratigraphic range comparable with the SRS and be allotted a linear, rather than doglegged, line of correlation to contribute this adjustment. However, Kleffner's analyses contained only a few sections with a scope comparable to the Cellon section and, of these, most had doglegs imposed (central Nevada; Pete Hanson Creek II; Bohemia). This, along with equal emphasis given to both bases and tops of ranges, appears to have made the analysis very conservative to adjustments. Certainly, the Cellon section appears to suffer badly from the skewing of the radiometric dates (Fig. 2) and to account largely for the problems with calibration of Kleffner's scheme.

There thus seems to be a strong *prima facie* case for substantial variations from steady accumulation in the Cellon section and for significant nonannularity in the resultant graphic-correlation analyses. As an indication of the possibility for an alternative basis for Silurian chronometry, the radiometric dates can be applied to, for example, the Gotland sequence. This produces a very good fit indeed (Fig. 3)[3]. Although the imposition of a single straight line is bound to be simplistic in detail, the resulting estimate of 419.5-418 Ma for the Přídolí must be considered at least viable for the present. We thus have more specifically stratigraphic reasons to support estimates for a short Přídolí such as those of Tucker & McKerrow (1995) and Tucker *et al.* (MS). It would now be interesting to examine other sections that include the Přídolí.

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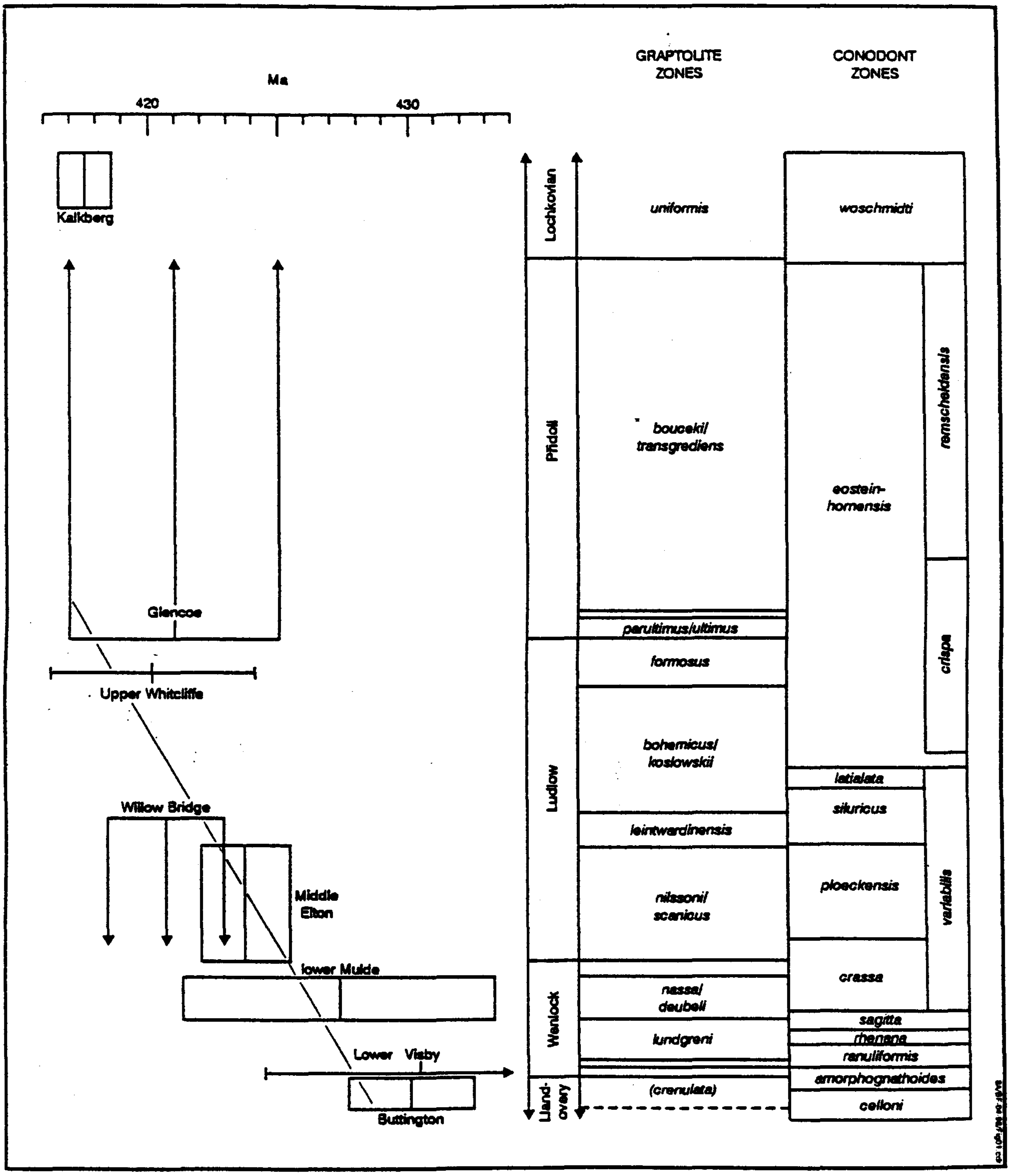


Figure 1. Part of Kleffner's (1995) Silurian graphic correlation, extended to top of *woschmidti* Zone following Fordham (1992), plotted against radiometric scale. Dates (with 95 % confidence bars) are from Kunk *et al.* (1985: Middle Elton), Odin *et al.* (1986: Lower Visby, Sample 102; lower Mulde, 108), Tucker & McKerrow (1995: Buttington, Item 24; Willow Bridge, 25 [=Laidlaw Volcanics], see Pickett, 1982, pp. 91, 95-98, 108-112 for stratigraphy; Upper Whitcliffe, 26; Glencoe, 27), and Tucker *et al.*, 1997, MS (Kalkberg). Line of calibration positioned visually and ignoring Kalkberg date.Figure 3. Gotland and Beyrichienkalk stratigraphy reconstructed by Jeppsson *et al.* (1994, Figs. 2, 3 -gaps ignored; Wenlock zones after Jeppsson, MS), extended to top of *woschmidti* Zone (by calibration of Berry & Murphy, 1983, Fig. 2) and to the lower part of the Viki core (following Jeppsson & Männik, 1993; graptolite correlations from Männik & Viira *in* Kaljo & Nestor, 1990, Table 13). Radiometric dates from Fig. 1. Line of calibration positioned visually.

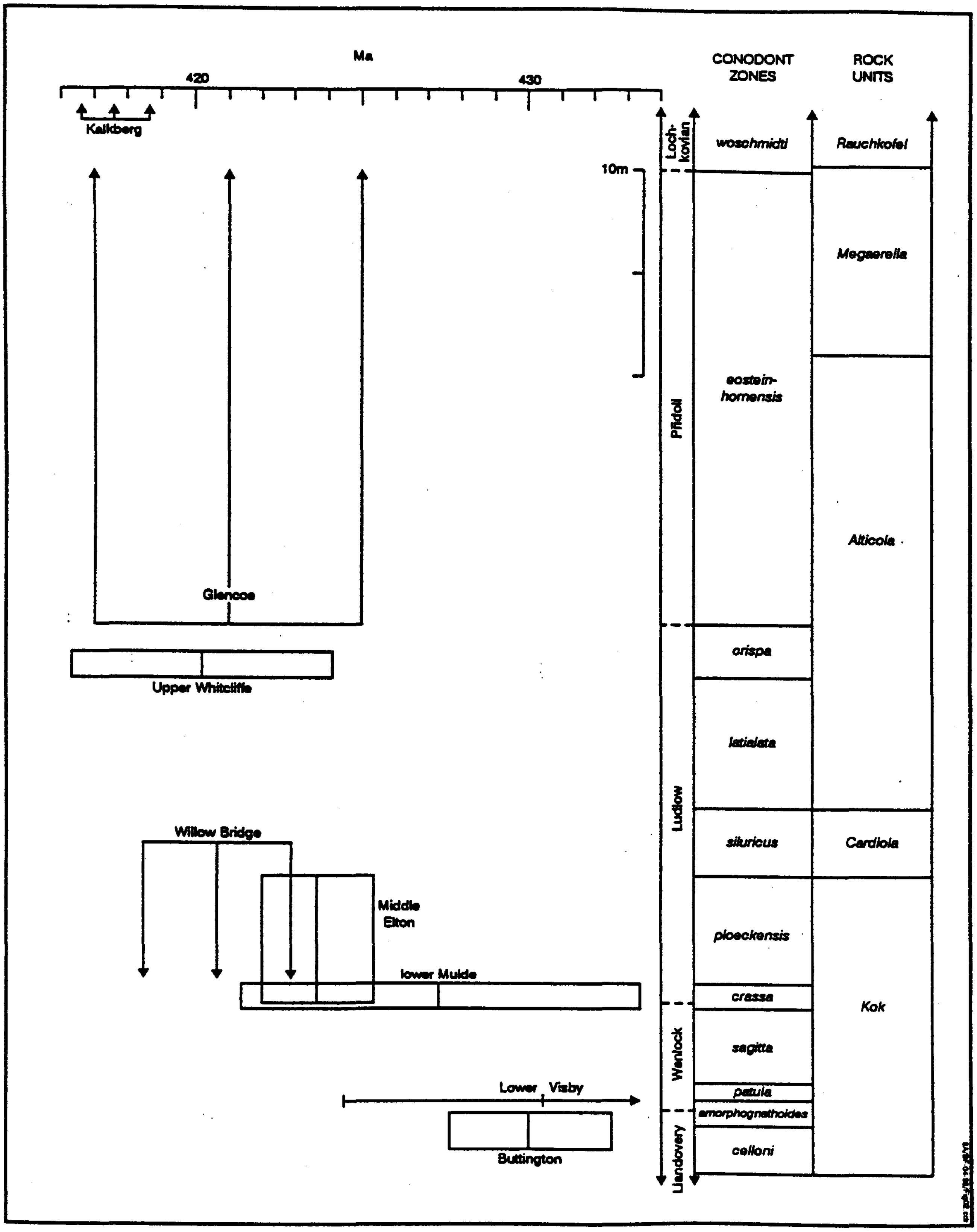
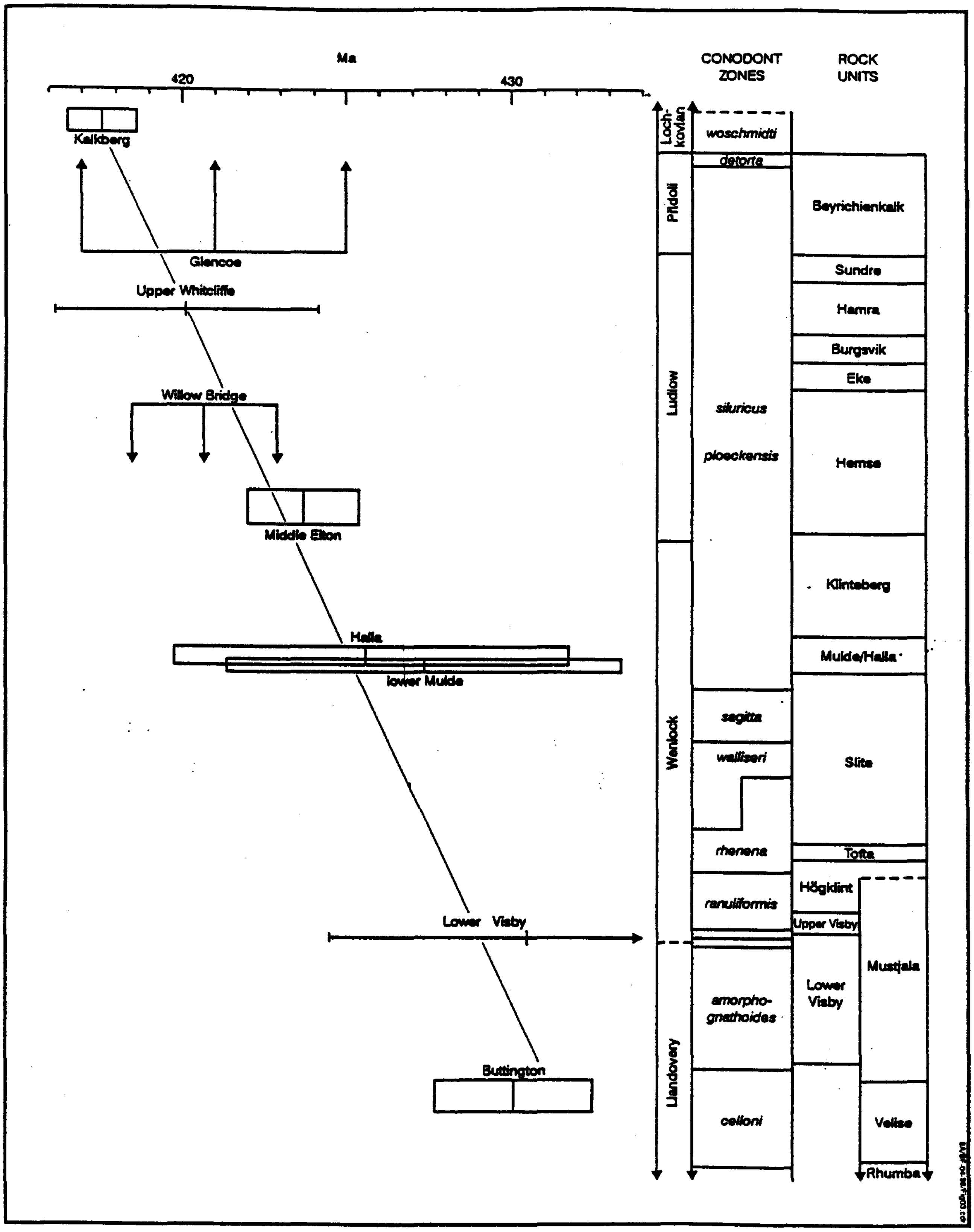


Figure 2. The Cellon section (see Schönlaub *et al.*, 1994) plotted against radiometric dates of Fig. 1.



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Notes in text

[1] Tucker & McKerrow (1995) did, in fact, prefer a short Přídolí of 419-417 Ma but this seems to have been based on the debatable assignment of the Arbuthnot Group to the lower Pragian, rather than the lower Gedinnian suggested by Richardson *et al.* (1984).

[2] Alternatively, attention could be focussed on the data outside the mid-Silurian to Lochkovian, but this is beyond the scope of this paper.

[3] The only hint of nonlinearity is the increased separation of the very similar Buttington and Lower Visby dates, but this may impact only on the Viki extension to the bottom of the sequence.

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