Supplementary Material

Mean Cycle Periodicity Calculations
Mean cycle periodicity values were calculated employing the same methodology as used by Pointon et al. (2012) for Namurian to early Westphalian siliciclastic cycles within the Pennine and Ruhr basins of northern England and Germany respectively. This is as follows:

Time duration between bentonites W8 and W13

\[
= \frac{\text{Bentonite W8 weighted mean } ^{206}\text{Pb} / ^{238}\text{U date (Ma)}}{\text{Bentonite W13 weighted mean } ^{206}\text{Pb} / ^{238}\text{U date (Ma)}}
\]

\[
= 335.59 \text{ Ma} - 332.50 \text{ Ma}
\]

\[
= 3.09 \text{ Ma}
\]

Uncertainty of the time duration between the two bentonites

\[
= \sqrt{\left(\text{uncertainty of bentonite W8 } ^{206}\text{Pb} / ^{238}\text{U date}\right)^2 + \left(\text{uncertainty of bentonite W13 } ^{206}\text{Pb} / ^{238}\text{U date}\right)^2}
\]

where date uncertainties are at the 95% confidence level and exclude systematic uncertainties arising from tracer calibration and the $^{238}\text{U}$ decay constant (i.e. the ± $X$ uncertainty level of Schoene et al. 2006).

\[
= \sqrt{(0.19 \text{ Ma})^2 + (0.07 \text{ Ma})^2}
\]

\[
= \pm 0.20 \text{ Ma}
\]

Mean cycle periodicity calculation

Mean cycle periodicity (ka / cycle) = \frac{\text{time duration between bentonites W8 and W13 (ka)}}{\text{number of intervening cycles}}
The uncertainty of the mean cycle periodicity estimate arising from uncertainties in the time duration (ka) is:

\[
\frac{1}{\text{number of cycles}} \times \text{uncertainty in time duration (ka)}
\]

These calculations are repeated for the minimum and maximum number of intervening cycles between bentonites W8 and W13 (25.5 and 28.5 cycles respectively; Table S1).

<table>
<thead>
<tr>
<th>Number of sedimentary cycles</th>
<th>Time duration (Ma)</th>
<th>Uncertainty in time duration (± Ma; 95% confidence)</th>
<th>Mean periodicity (ka / cycle)</th>
<th>Uncertainty in mean periodicity (± ka / cycle)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between bentonites W8 and W13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25.5</td>
<td>3.09</td>
<td>0.20</td>
<td>121</td>
<td>8</td>
</tr>
<tr>
<td>28.5</td>
<td>3.09</td>
<td>0.20</td>
<td>108</td>
<td>7</td>
</tr>
</tbody>
</table>

**Table S1.** Mean periodicity estimates for early Warnantian sedimentary cycles calculated using the new U–Pb zircon CA-ID-TIMS dates from bentonites W8 and W13

**References**
