**Table S3.** The fossil constraints used in PAML *mcmctree* divergence time estimation.

|  |  |  |  |
| --- | --- | --- | --- |
| Calibration nodes | Fossil calibration | Date range (Ma) | Reference |
| Min | Max |
| Mollusca: Aculifera, Conchifera | *Oelandiella* | 530.7 | 538.8 | (Song et al., 2023) |
| *Potamilus streckersoni*, *Chlamys farreri* | *Glyptarca* | 477.08 | 497.0 | (Song et al., 2023) |
| *Nautilus*, *Octopus* | *Devonobactrites emsiense* | 394.3 | 486.9 | (Song et al., 2023) |
| *Octopus*, *Euprymna* | *Tohokubelus takaizumii* | 246.7 | 359.3 | (Song et al., 2023) |
| *Haliotis*, *Pomacea* | *unnamed larval gastropod shells*  | 469.42 | 497.0 | (Song et al., 2023) |
| *Pomacea*, *Biomphalaria* | Kuskokwimia *moorei* | 394.3 | 477.08 | (Song et al., 2023) |
| Unionida, Cardiida | *Silesunionidae* | 208.5 | 237.0 | (Skawina and Dzik, 2011) |
| Ampullariidae, Batillariidae | *Reesidella robusta, R. rinra* | 145.0 | 163.5 | (Hayes et al., 2009) |
| Planorbidae, Lymnaeidae  | *Lymnaea morrisonensis*  | 152.1 | 157.3 | (Gray, 1988) |

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