Estonian Journal of Earth Sciences
2023, **72**, 1, 140

https://doi.org/10.3176/earth.2023.41

www.eap.ee/earthsciences
Estonian Academy Publishers

When lingulid brachiopods became infaunal(?) – perspectives from the morphological and anatomical information

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ABSTRACT

Morphology usually serves as an effective proxy for functional ecology, and the evaluation of morphological, anatomical, and ecological changes allows for a deeper understanding of the nature of diversification and macroevolution. Lingulid (Order Lingulida) brachiopods were diverse and abundant during the early Palaeozoic, but decreased in diversity over time, with only a few genera of linguloids and discinoids present in modern marine ecosystems, frequently referred to as 'living fossils'. The dynamics that drove this decline remain unclear and it has not been determined if there is an associated decline in morphological and ecological diversity. We applied geometric morphometrics to reconstruct global morphospace occupied by lingulid brachiopods through the Phanerozoic, with results showing that maximum morphospace occupation was reached in the Early Ordovician. At this time of peak diversity, linguloids with sub-rectangular shells already possessed several evolutionary features common to all modern infaunal forms such as the rearrangement of mantle canals and reduction of the pseudointerarea. The end-Ordovician mass extinction had a differential effect on linguloids, disproportionally wiping out those with rounded shells whilst forms with sub-rectangular shells survived both the end-Ordovician and the Permian–Triassic mass extinctions, with post-extinction faunas predominantly composed of infaunal forms. For discinoids, both morphospace occupation and epi-benthic life strategies remain consistent through the Phanerozoic. Analysis of the morphospace occupation of lingulids over time, taking into account their body size, anatomical features and ecological changes, suggests that the reduced morphological and ecological diversity observed in modern lingulid brachiopods reflects evolutionary contingency rather than deterministic processes.

Received 28 March 2023
Accepted 13 May 2023
Available online 14 June 2023

Keywords:
macroevolution, morphospace, brachiopods, mass extinctions, contingency

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Citation:
Liang, Y., Strotz, L. C., Topper, T. P., Holmer, L. E., Budd, G. E., Chen, Y. et al. 2023. When lingulid brachiopods became infaunal(?) – perspectives from the morphological and anatomical information. *Estonian Journal of Earth Sciences*, **72**(1), 140. https://doi.org/10.3176/earth.2023.41

14TH ISOS
ESTONIA 2023