Estonian Journal of Earth Sciences
2023, **72**, 1, 141

https://doi.org/10.3176/earth.2023.17

www.eap.ee/earthsciences
Estonian Academy Publishers

The morphological disparity, ecological evolution and palaeobiogeography of Palaeozoic hyoliths

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ABSTRACT

Hyolitha is a group of extinct invertebrates, the most dominant benthic animals within the Cambrian evolutionary fauna and forming a part of the Palaeozoic evolutionary fauna. Hyoliths are generally divided into two groups, Orthothecida and Hyolithida. They originated in the Terreneuvian and experienced a rapid diversification during the Cambrian Explosion but reached a diversity bottleneck during the Cambrian extinction (Sinsk Event). Hyoliths were characterised by low disparity beginning from the Ordovician and got extinct in the Permian. Factors that affected the evolutionary pattern of Palaeozoic hyoliths from the early domination period up to extinction are poorly known. Herein, we collected material on 148 Palaeozoic hyolith genera from around the world and documented their key morphological characters and distributions. Combined with the phylogenetic analysis based on a matrix of morphological characters, the nonmetric multidimensional scaling (NMDS) using the Paleontological Statistics Software Package, and palaeobiogeographical data, we intended to analyse the biodiversity changes during the evolutionary history of hyoliths and uncover the influence of morphological selectivity in different palaeoenvironments, from the Cambrian to the Permian.

Our results showed that the Cambrian taxa occupied quite a different morphospace compared to that of the Ordovician–Permian assemblages. The morphology of the early Cambrian hyoliths was mainly simple, comprising long conical weakly ornamented tubes. They radiated worldwide during the Cambrian 'Epoch 2', reaching high disparity and diversity, but faced a disadvantageous situation after the mid-Cambrian. The younger genera with strong ornamentation usually showed low diversity and provincialism during the Ordovician. The morphological shift from a simple conical tube morphology with weak ornamentation (orthothecids of the early Cambrian) to a complex morphology with distinct venter and dorsal pyramidal conch and strong ornamentation from the late Cambrian up to the Permian reflects ecological evolution of the hyoliths. This was accompanied by a change of their feeding habits from active deposit-feeding to passive suspension/filter feeding and change in conch configuration from rheophilic to non-rheophilic.

Received 31 March 2023
Accepted 19 April 2023
Available online 16 June 2023

Keywords:
hyoliths, Cambrian, palaeobiogeography, morphospace, evolutionary pattern

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Citation:
Liu, F., Topper, T. P., Strotz, L. C., Liang, Y., Skovsted, C. B. and Zhang, Z. F. 2023. The morphological disparity, ecological evolution and palaeobiogeography of Palaeozoic hyoliths. *Estonian Journal of Earth Sciences*, **72**(1), 141. https://doi.org/10.3176/earth.2023.17

14TH ISOS
ESTONIA 2023