Biodiversity across space and time in the Cambrian

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Abstract

The fossil record is the primary source of information on how biodiversity has varied through deep time, providing unique insight on long-term dynamics of diversification and their drivers. Here we use fossil occurrence data from the Paleobiology Database (https://paleobiodb.org) to show diversity patterns during the Cambrian Radiation, particularly focusing on how the biodiversity varied along environmental and geographic gradients. The scope of this study refers to niche evolution and biogeography, and the aim of this study is to untangle ecological drivers of biodiversity changes at various spatial scales. We refined the biostratigraphic framework to delineate time slices for the Cambrian Period to improve the precision of temporal resolution. We applied several sampling-standardization methods to deal with taphonomic and sampling biases. By assessing how the overall increase in global diversity was partitioned between within-community (alpha) and between-community (beta) components and how beta diversity was partitioned among environments and geographic regions, we found that a rapid differentiation in faunal composition occurred at both local and regional scales in the early Cambrian, suggesting that global biodiversity during the Cambrian Radiation was driven by niche contraction at local scales. Using a compositional network, we outlined time-traceable provinces across the Cambrian Period and results confirm that abrupt biogeographic differentiation was facilitated by a decrease in by-species geographic distribution during the first three stages. A slight decreasing trend in biodiversity out-of-tropics is also evident in our results, indicating a latitudinal control on biodiversity in the Cambrian. By comparing our results with continental reconstruction and climate models, we concluded that both tectonic history and climate change may have played critical roles in driving spatio-temporal structure of biodiversity in the Cambrian.

Keywords: Biodiversity, Cambrian

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